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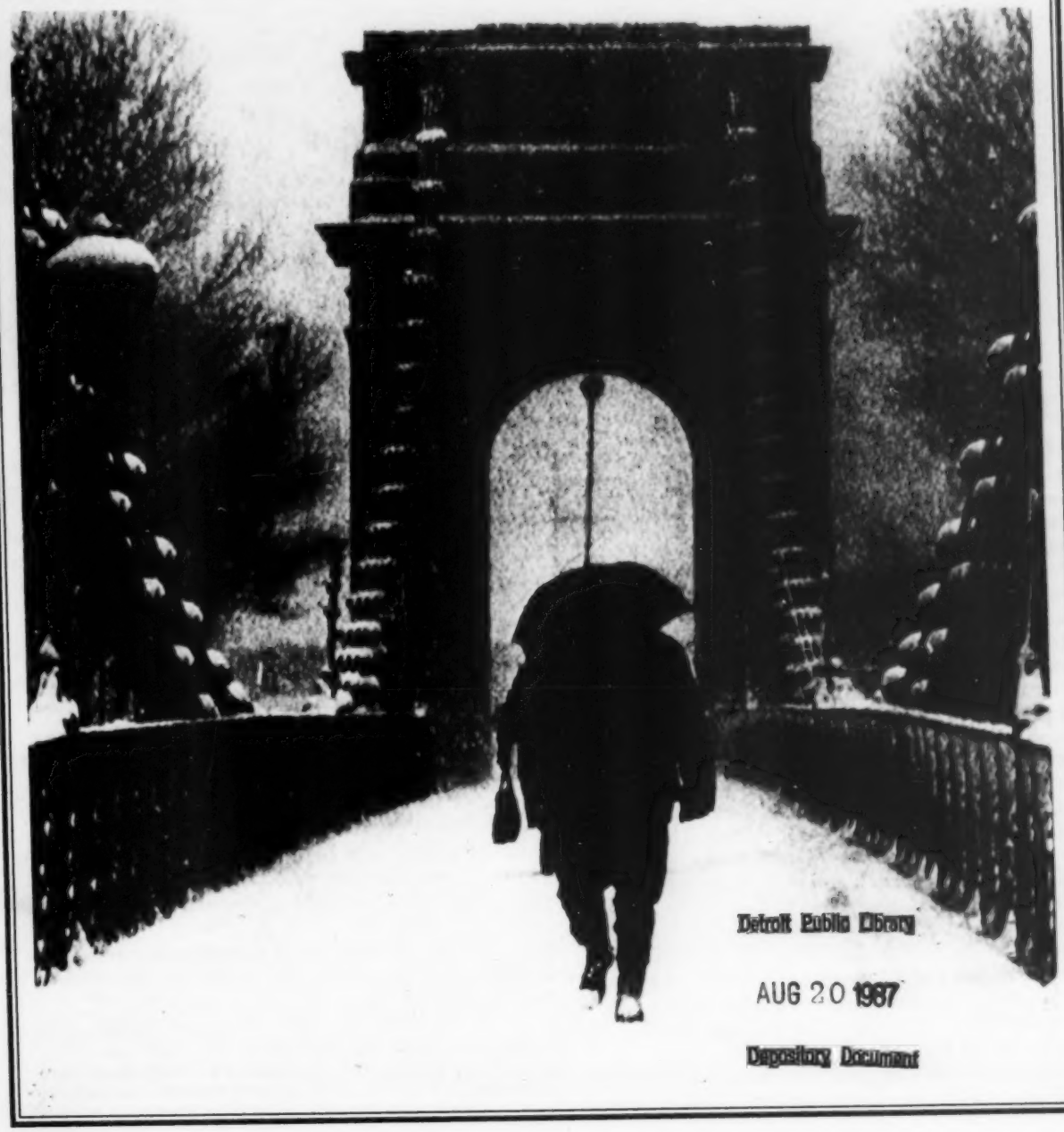
Mariners Weather Log



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Risk

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Galveston, Texas on September 9, 1900 — Will it happen again?

"Hundreds of corpses were strewn among the farms, unknown except to the vultures which flocked about them. Whole families are wiped out in some places. The coroner has sworn in an army of deputies and these are hunting for the dead."

So reads a press account of a hurricane that ravaged the coasts of Georgia and South Carolina in August 1893. It was accompanied by a tremendous storm surge which left at least a thousand dead.

If this same hurricane, or the Galveston storm, struck this season, would the scene be different? According to Neil Frank, director of the National Hurricane Center, "hundreds of lives could be lost in a major hurricane this year if coastal residents and visitors fail to perceive the danger and act quickly." The residents in 1893 had little warning and poor evacuation routes. Today, despite the warnings most people will wait till the last minute and the evacuation routes would become congested and about as useless as the trails a hundred years ago. People would die in their cars instead of on the farms.

"The greatest peril may be apathy" Frank said. He expressed concern that the people who experienced Gloria in 1985, which was billed as one of the most powerful of all North Atlantic storms, might not realize what a close call they had. Gloria stayed just far enough off the mid Atlantic coast to minimize damage and weakened over cold water off New England where it fortunately arrived at low tide.

The greatest hurricane danger is the storm surge, a dome of lashing water that sweeps ashore ahead of the hurricane eye. Nine out of ten who die in a hurricane, drown.

The National Weather Service strives to provide 24 hours' warning of where a hurricane will reach the coast. These monsters are often unpredictable and often increase rapidly in intensity. If you live, work or play on the Atlantic or Gulf Coast, including mariners visiting by ship, caution should be observed through November.

"Evacuations studies for many coastal areas have shown that decision-makers need anywhere from 20 to 30 hours' warning if they expect to order complete evacuation before a hurricane hits," Frank said.

The danger is increasing each year, Frank noted, due to exploding Gulf and Atlantic coastal populations, which have grown by 34 percent since 1960. The problem is even more serious in Florida where coastal populations have increased by 82 percent, and in Texas where the coastal growth has been 54 percent.

Neil Frank's Hurricane Safety Tips

—Monitor National Weather Service forecasts regularly, and be ready to act if a hurricane notice is issued,

—Know the locations of shelters and evacuation route,

—Prepare to leave when a hurricane watch is issued, and stay continually in touch with forecasts,

—Leave immediately if a warning is issued.

— If long-distance evacuation is impossible, seek shelter in the area. If designated shelters are not available, go to sturdy structures as far from shore as possible.

Mariners Weather Log

July—August—September, 1987
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Wilhelmenia L. Bowe

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 1, 1988.

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Cover: With Europe's transport disrupted from Scandinavia to Italy, Scots travel by foot across the River Clyde in Glasgow in January. **Wide World Photo.**

Back Cover: While Cape Cod is now wrapped in the summer sun it wasn't long ago (February) that it wore a mantle of white. **Boston Globe Photo.**

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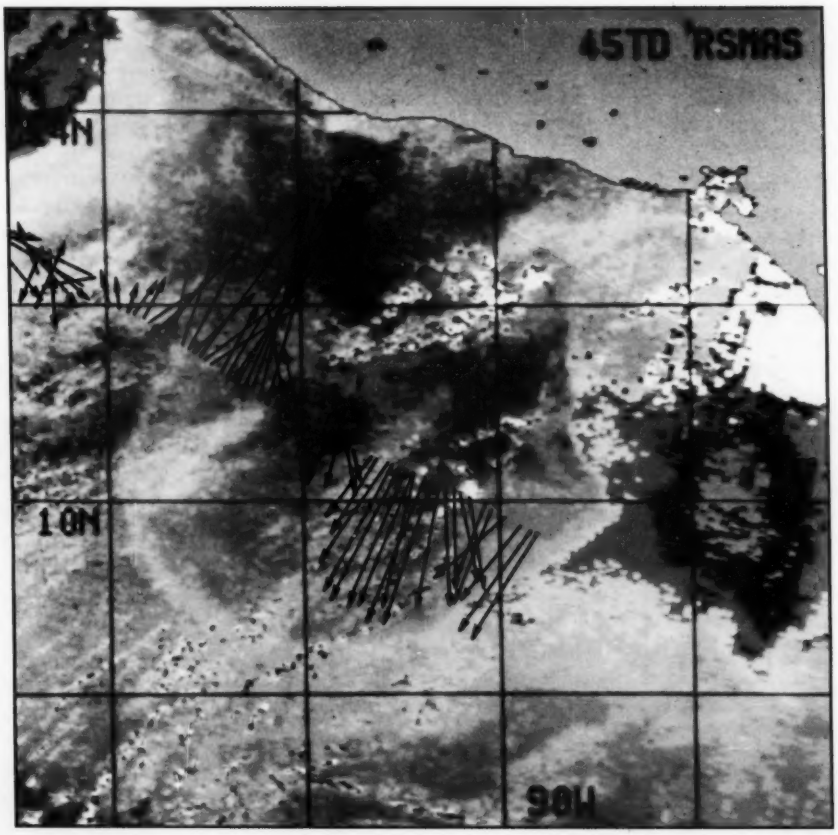
watch out



The warm surface water of an eddy shows up as a light circular patch in this heat-sensitive satellite image of the Gulf of Tehuantepec off the Pacific coast of Mexico. The superimposed lines show the direction and relative speed of actual current measurements made by the ***Exxon Jamestown.*** *Change in current direction as the ship crossed the approximate center of the eddy indicates a water mass in clockwise rotation.*

for Nelson Eddy

by Sandford Brown

(from *The* LAMP, Spring 1987)

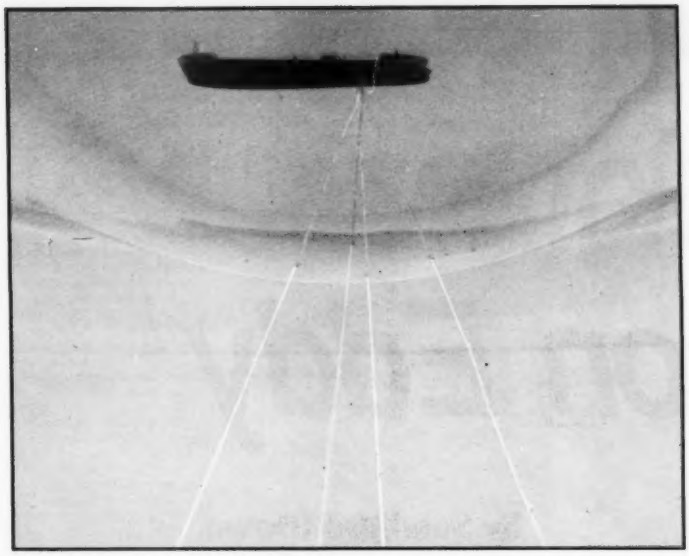
"Bob Gordon of Exxon Production Research has just told me that the Loop Current in the Gulf has shed another large eddy, which may lie in your usual path. We would, therefore, like to make extra drops in certain areas..."

Gulf of Mexico Special!" said a radio message from the Scripps Institution of Oceanography addressed to officers of the *Exxon Jamestown*, a 41,000 dwt tanker which carries crude oil from Exxon's Hondo platform off southern California to the Baytown refinery in Texas. "Bob Gordon of Exxon Production Research has just told me that the Loop Current in the Gulf has shed another large eddy, which may lie in your usual path. We would, therefore, like to make extra drops in certain areas ..."

The message came from Dr. David Cutchin, an oceanographer whose job at Scripps is admininistering a project called the Volunteer Observing Ship Program (VOSP). VOSP uses XBT's, torpedo-shaped devices called expendable bathythermographs, to measure temperatures at different water depths. Oceanographers have always had a hard time collecting enough data on their subject, which covers three quarters of the globe but must be studied at close hand to yield information of much value. "One problem with ocean research is that it takes you a long time to get anywhere," says Cutchin, whose office at Scripp's LaJolla, California headquarters is on a bluff overlooking the Pacific. "And it's expensive. A research vessel costs $10,000 a day to operate, minimum, and your equipment must be in perfect running order. If something goes wrong out at sea, your whole project could be ruined."

To extend their reach, researchers place equipment aboard freighters, tankers and other 'ships of opportunity' whose operators volunteer to collect scientific data in the course of their regular rounds. The National Weather Service, for example, relies on such ships to radio weather reports. Scripps' VOSP program began in 1974, with the Navy providing support; today, most of its funding comes from the National Oceanic Atmospheric Administration (NOAA) and the National Science Foundation (NSF). It currently enlists the help of some three dozen ships from a dozen countries.

The VOSP program focuses on the Pacific where, trailing a thin copper wire sheathed in plastic, an XBT is dropped over the side of a ship to take temperature



An ocean eddy (represented here by a plastic model) is a revolving "bowl" of water in the sea. To measure eddy currents, equipment on the Exxon Jamestown transmits beams of sound, and records frequency changes in echo returns from each beam to determine how fast the water is moving relative to the ship. Echo-ranging equipment enables currents at various depths to be computed. Original color illustration produced by Nicholas Fasciano.

readings. The XBT sends them back as electromagnetic signals as it sinks to the end of its 1,500-foot tether, finally breaking away to plunge to the bottom. Since the program began, Cutchin estimates that more than a million temperature readings have been taken by XBTs and passed to Scripps for analysis.

"Data from the Pacific survey may help scientists explain the origin of El Nino,...."

The *Exxon Jamestown*, a VOSP participant since 1983, deploys XBTs in two oceans — between Los Angeles and the Panama Canal on the Pacific leg of its route and in the Gulf of Mexico on its Atlantic leg. Data from the Pacific survey may help scientists explain the origin of "El Nino," the mysterious climate aberration which brings storms and floods to the west coast of the Americas. Readings in the Gulf have special interest for Exxon and other oil companies studying ocean eddies — masses of rotating water which pack enough energy to be a menace to exploration and production operations in the world's busiest offshore oil province.

Driven by trade winds, a powerful ocean current flows north from the Caribbean to the Gulf through the straits between Mexico and Cuba. Part of the current bends eastward and surges through the Straits of Florida to the Atlantic as the Gulf Stream; another part turns westward and follows a looping course through the middle of the Gulf. The eddies are swirls of water spun off the edges of this " loop current" to meander through the Gulf on their own. Usually warmer than the surrounding sea, an eddy can be as much as 200 miles in diameter and 1,500 feet deep at its central core. It may travel for hundreds of miles and last for a year or more.

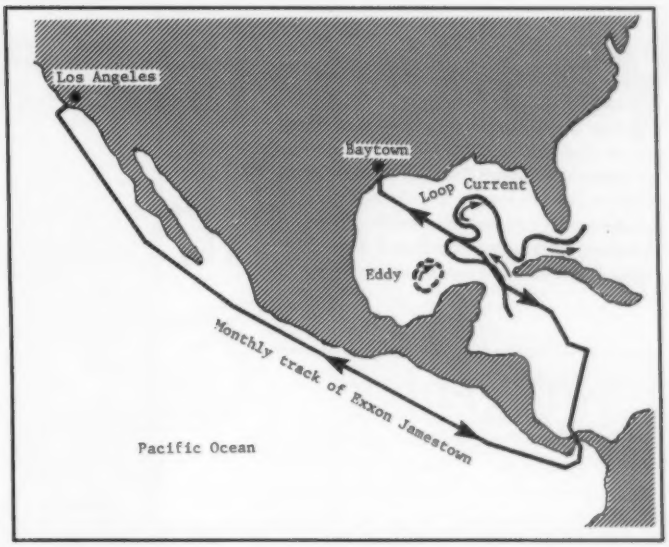
While eddies move in majestic slow motion, their rotation speed of three to four knots far exceeds the speed of most ocean currents, which average a fraction of one knot. A large mass of water moving this fast builds up astronomical amounts of energy; currents in the Gulf Stream have torn away current meters moored with one-inch steel cables. Eddy currents can cause serious vibration or actual structural failure in the riser pipe used in offshore drilling to provide a conduit between the floating rig and the sea floor. In the deep waters of the Outer Continental Shelf (OCS), beyond the 600 meter depth line, they even pose a threat to massive production platforms.

"We are all waiting for Nelson Eddy..."

Under oil industry sponsorship, an oceanographic survey company has been carrying on a program called "Eddy Watch" since 1984. Using satellite imagery sensitive to surface water temperatures, the company monitors "thermal features" in the Gulf, and alerts the industry to anything which looks like an eddy.

Like hurricanes, eddies are given alphabetical names which denote their order of appearance, with the sequence dating to the start of Eddy Watch. Eddy No. 6, dubbed "Fast Eddy " when first spotted in mid-1985, and "Hot Core Eddy," No. 8 , which the *Jamestown* crossed last spring, are still drifting off the Texas coast. "Ghostly Eddy," so named because it kept appearing and disappearing, has apparently vanished for good. "We are all waiting for Nelson Eddy" says Bob Haring, section manager for offshore technology at Exxon Production Research Company— though it will take six more eddies before an 'N' name is needed.

Haring's section is charged with evaluating sea conditions in areas where Exxon operates, analyzing the risks posed to off-



Route of the Exxon Jamestown from Los Angeles to Baytown crosses ttropical eddies in the Pacific and Gulf of Mexico—the latter of particular interest to engineers concerned with the effects of eddies on offshore production operations. Currents from the Caribbean swing east to form the Gulf Stream and northwest to form the loop current. Eddies are masses of water which break off the loop current to drift erratically through the Gulf.

shore operations by storms and other hazards. Eddies seem to occur at random, which complicates the job of risk analysis. "We can survey one eddy, but we need historical data to see the prob- abilities of eddies recurring," Haring explains. "The key word in offshore operations is preparedness. You don't want to get caught by something taking you by surprise."

Eddies caused serious problems for an Exxon exploration project off the coast of Brazil a few years ago, pushing drillships off station and forcing drillers to use special risers fitted with vanes to reduce drag. At the moment, the company has few drilling operations in waters susceptible to eddies, and its only deep-water producing platform, the Lena platform off the Mississippi Delta, is well north of the usual path of Gulf eddies. But with the OCS offering the best chances for finding major new supplies of oil and gas, there is good reason to learn more about these phenomena.

Exxon and seven other oil companies have set up an Eddy Joint Industry Program (EJIP) to study Gulf eddies more closely. Where Eddy Watch merely tracks new eddies as they appear, EJIP involves on-the-spot measurements of eddy currents. "The main use for this data is in planning drilling operations and in platform installation studies," says John Vermersch, an oceanographer and EPR research associate who spearheads Exxons role in the program. "Eddies occur mostly near the western shores of the oceans, and contingency planning might allow for some eddy downtime in these areas — typically 20 days a year. If we knew we were venturing into such an area, we would use high—current drilling equipment to reduce drag." While eddies don't normally move close to the coast, some may do so. "The big question is what happens to them when they hit shallow water,." says Vermersch. "Is their enormous energy dissipated, or is it concentrated and compressed in a smaller area?"

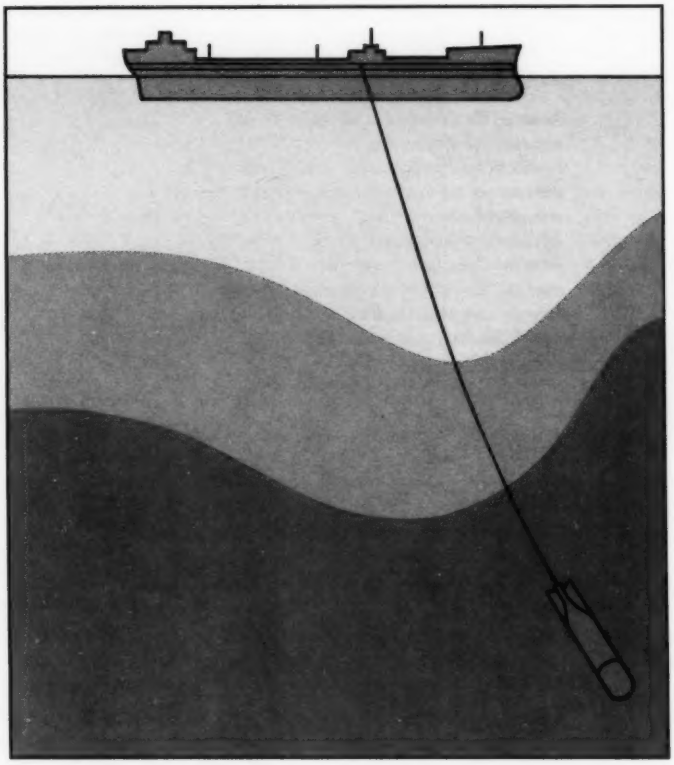
The XBT's deployed in the Gulf by the *Exxon Jamestown* make an important contribution to the EJIP study as well as oceanographic studies being conducted by Scripps and other research organizations. By dropping an XBT and its trailing wire off the wing of the bridge at prescribed intervals, the ship's officers construct a temperature profile of the water passing beneath the ship. An eddy which might escape detection by satellite imaging is revealed by its XBT profile, which typically would show a bowl-shaped mass of warm water extending to a considerable depth at its center.

The *Jamestown* also measures the strength and direction of eddy currents by means of acoustical echo-ranging. Like many vessels, the ship is equipped with an acoustic speed log which sends out four beams of sound fore and aft and to starboard and port; by Doppler measurements of echo returns from the moving water, the log computes the ship's speed relative to the sea. Scripps scientists have 'piggy-backed' an echo-ranging device on this log which enables it to get echoes from water at different depth levels. When the ship's speed is factored out, the device shows how fast the water itself is moving at various depths below the ship.

"XBT readings have shown us what the El Nino looks like..."

The log detected strong right-to-left currents beneath the *Jamestown* when the ship entered "Hot Core Eddy" last spring. After several hours of steaming, the currents changed abruptly to a strong left-to-right set—a clear indication the ship had crossed the centerline of a massive body of water in clockwise rotation.

The *Jamestown* is the only vessel in the VOSP program equipped to make such current measurements. Capt. Richard Knoop and his fellow officers collect both XBT and acoustical data on every trip, deploying the equipment in both the Gulf and in tropical waters on the Pacific side. They radio each day's readings to Scripps via the Coast Guard, and also plot a graph of the readings on tape. At the end of each run, Dave Cutchin picks up the tape car-



Expendable bathythermographs (XBTs) are torpedo-shaped devices deployed by vessels to measure water temperature at various depths in the sea. An XBT sends back a series of temperature reading as it sinks to the end ot its tether of copper wire before finally breaking away. When a ship crosses a tropical ocean eddy, the pattern of temperature gradients show a mass of warm water extending from the surface to depths of a quarter mile or more.

NOAA EDDIES

NOAA has several products that help keep track of eddies. Two Oceanographic Analysis charts are derived from thermal infrared satellite imagery, backed by ship observations. The northwest Atlantic Oceanographic Analysis covers the area from 30°N to Cape Hatteras, NC and east to 47°W. This chart is produced on Mondays, Wednesdays and Fridays. The second chart covers the southern North Atlantic from Cape Hatteras to Florida and the Gulf of Mexico.

It is produced on Tuesdays and Thursdays. NOAA also produces an automated satellite-derived Sea Surface Thermal Analysis chart twice a week. This chart features isotherms as well as the location of warm and cold eddies. It covers the Gulf Stream. All these charts are available through the mail on a subscription basis. They are also available on telecopier. If you have a radiofacsimile receiver, the oceanographic analysis charts can be accessed in real time. Monthly sea surface temperatures, means and anomalies are summarized in the "Oceanographic Monthly Summary". Eddy information can also be found in the Gulf Stream Wall Bulletin, which is available by radio and computer. For further information on all these products contact:

Ocean Services Unit
National Weather Service Forecast Office
World Weather Building, Room 302
Washington, DC 20233
Tel: 301- 763-8239

tridges, debriefs the officers on their observations, and makes any necessary adjustments in the equipment or the deployment plan. "It's real easy to drive up to L.A. and tweak it," says Cutchin. 'The *Jamestown* travels through a lot of interesting areas. I didn't realize how active the oceanography was along its route."

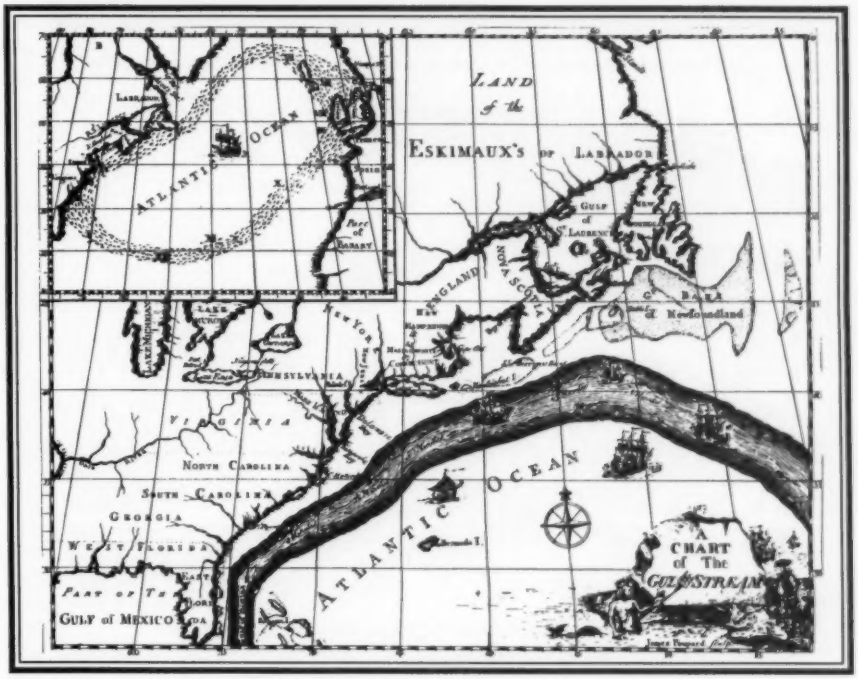
One area of particular interest to Scripps is the Gulf of Tehuantepec off Mexico's Pacific coast, where VOSP data in 1982 showed a thick layer of warm water on the ocean's surface. It signaled the onset of the destructive phenomenon known as El Nino, which periodically brings storms, floods and/or drought to vast areas of the world, usually hitting hardest at the west coast of South America. The name El Nino (The Child) is a Spanish allusion to the Christ child, denoting the fact that the disturbance often occurs around Christmas, though there seems to be no sure way of telling when it will come or how hard it will hit. The 1982-1983 El Nino turned out to be one of the most savagely destructive ever recorded, bringing disastrous floods to Ecuador and Peru, ravaging the coast of California with storms, and causing brutal droughts in southern Africa and in Australia. It killed more than 1,100 people and caused property damage of nearly $9 billion.

There is no doubt that El Nino is caused by a shift in the grand pattern of high and low pressure systems which normally prevails over the Pacific. But exactly what triggers this shift in the interaction between the ocean and the atmosphere is still a mystery. A multi-nation research project called the Tropical Ocean Global Atmospheric (TOGA) study, in which Scripps is participating, could pin down the answer.

"XBT readings have shown us what El Nino looks like and how it propagates across the Pacific," says Dr. Warren White, scientific director of the VOSP program at Scripps. 'The TOGA study will enable us to predict El Nino up to a year in advance — an early warning which would be invaluable in reducing its impact."

Navigational Safety — A DMA Tradition

Edward Pace
DMA Representative
New Orleans, LA

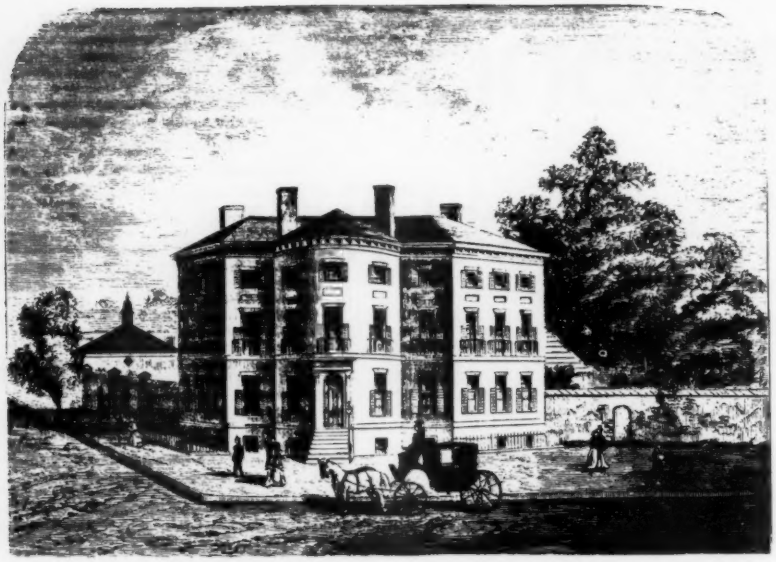


The U.S. Navy's commitment to navigational safety and ocenaography can be traced back to Ben Franklin , seen chatting with King Neptune in this chart , which illustrated the publication in 1786 of Franklin's "Marine Observations," the first scientific observations of the "river in the ocean."

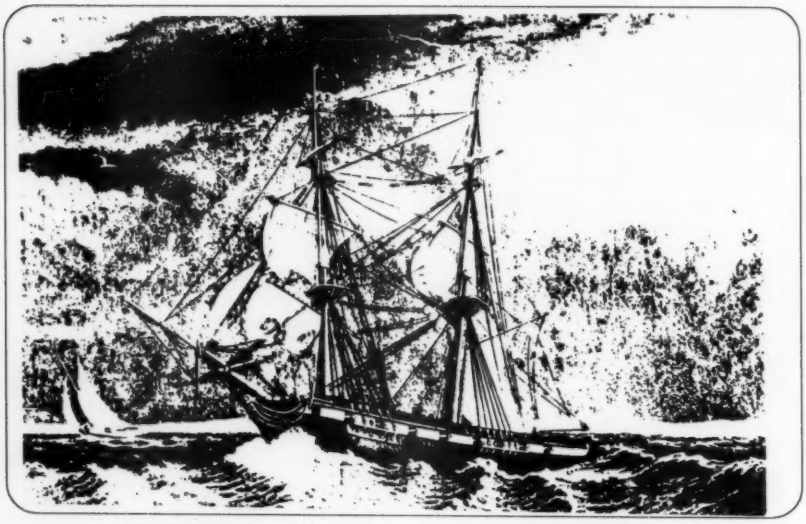
When Benjamin Franklin published his historic chart of the Gulf Stream, in 1770, it was one of America's earliest presentations of navigational information. Mariners were able to avoid this strong northerly current when sailing southward and use it to advantage when heading north. However, it invited potential danger by guiding ships close to Diamond Shoals, an area that became known as the "Graveyard of the Atlantic".

These early mariners relied mainly upon experience, if they survived, and each other for navigational safety information. There was little available in the way of charts or data on weather, currents and other hazards to navigation. The Sign of the Quadrant, a commercial firm established in New York in the late 1700's provided some assistance. Then in 1830 the U.S. Navy established the Depot of Charts and Instruments, which became the Hydrographic Office in 1866 and finally evolved as part of the Defense Mapping Agency (DMA) more than 85 years later.

Whether you remember it as "Hydro" or know it as DMA, this service was built upon, and continues the tradition of, ensuring safety at sea. The foundation of this tradition continues to be the free and willing exchange of information between mariners.



The Octagon House was the site of the first U.S. Hydrographic Office, 1866-1879.



*The U.S. Brig **Porpoise**, under the command of Lt Charles Wilkes and in company of the **Maria** and **Badassah**, conducted the first survey authorized by the Depot of Charts and Instruments.*

A cooperating observing program was started in 1842 by Lieutenant Matthew Fontaine Maury whose work in hydrography earned him the title "Pathfinder of the Sea." This system encouraged both Navy and merchant ships to make available to the Depot their observations of ocean currents, winds and other marine meteorological phenomena. So successful was Maury's cooperating observer program that it came to the attention of other maritime nations. Consequently, an international conference was held in Brussels, Belgium in 1853. Considered the forerunner of the International Hydrographic Bureau and the International Marine Meteorological Organization, the conference's sole purpose was to start an international program similar to Maury's, with mariners from all maritime nations forwarding their observations to their own hydrographic offices.

Maury's accomplishments were extraordinary, his vision boundless. From his efforts evolved the National Weather Service, which continues cooperating observer and ship visiting programs of its own.

DMA today still has an active collection program for navigational data on a worldwide basis. Reports received from mariners are evaluated using other source material on hand to provide safe navigational information. Urgent information is broadcast as navigational warnings, published in Notice to Mariners, and incorporated in nautical charts and publications (mariners can obtain this same information by direct access to DMA'S Automated Notice to Mariners System (ANMS) data base. Many sophisticated methods are used to collect information; these include formal surveys, aerial photography, and Landsat satellite data, but we still rely heavily on the mariner as the most important source.

The Cooperating Observers Program, in which ship captains sign up to send in regular reports to DMA, is an important part of the collection effort. Ship crews that participate in this program are entitled to have mailed to their U.S. address, weekly Notices to Mariners and the North Atlantic and North Pacific Pilot Charts. Mariners are provided collection kits, which contain the publication "Guide to Marine Observing and Reporting", a Bathymetric Data Collection Priorities Chart, reporting forms, and addressed, postage-paid envelopes. These kits make reporting more convenient.

Those who are interested in the program are requested to write:

Director, DMA Hydrographic/ Topographic Center
ATTN: SD(SDSCH)
Washington, DC 20315-0030

An alternative would be to contact one of the three DMA representatives whose function is to collect data.

Data Collection kits are also available from the National Weather Service Port Meteorological Officers listed in the Mariners Weather Log. DMA gratefully acknowledges the cooperation of the National Weather Service in this most important effort.

To the many mariners who have continu-

ally participated in the Cooperating Observers Program by sending in their suggestions and reports, DMA extends its most sincere thanks. It is through this wonderful spirit of cooperation that charts and publications can be improved, with the result that the sea lanes can be made safer for all ships.

Despite these programs and others designed to make the sea as safe as possible the final responsibility remains in the hands of the mariner. This fact is reinforced by an historic message received at the Hydrographic Office and still displayed at DMA. The message originated by the German ship SS America warned of passing two large icebergs. The Titanic, on her maiden voyage, received the warning and, with her powerful radio transmitters, relayed it to Cape Race. It is cruel irony that the Titanic failed to heed this warning, and struck one of those icebergs and sank on that fateful night of April 15, 1912.

DMA

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26 Federal Plaza,
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Hydro and the Mariner

1770 First map of the Gulf Stream published by Benjamin Franklin.

1775 Marine committee established by the Continental Congress equipped two ships, one of 14 guns and one of 10; this was the birth of the U.S. Navy.

1798 'Navy Department' established under a Secretary of the Navy.

1802 First edition of Bowditch – 'The New American Practical Navigator'.

1830 December 6th marked beginning of the Hydrographic Office, when Navy established Depot of Charts.

1842 Lt. Maury appointed Supt. of the Depot of Charts and Instruments.

1844 Maury began the collection of information from the logs of vessels to make wind and current charts.

1847 First 'Wind and Current Chart of the North Atlantic' published. Predecessor of Pilot Chart.

1853 U.S. instigated International Maritime Conference at Brussels, Belgium to help establish an international exchange of nautical and oceanographic information.

1854 The office became the U.S. Naval Observatory and Hydrographic Office.

1862 Office was transferred to Bureau of Navigation.

1866 By act of Congress, Hydrographic Office and Naval Observatory separated.

1869 First 'Notice to Mariners' issued by the Hydrographic Office.

1883 First branch Hydrographic Offices established at Boston, New York, Philadelphia and Baltimore to better serve the mariner.

1921 Marine radio broadcasts inaugurated by Hydro, so mariners at sea could be notified of dangers to navigation.

1944 Over 43 million charts printed and issued by Hydro during this peak World War II year.

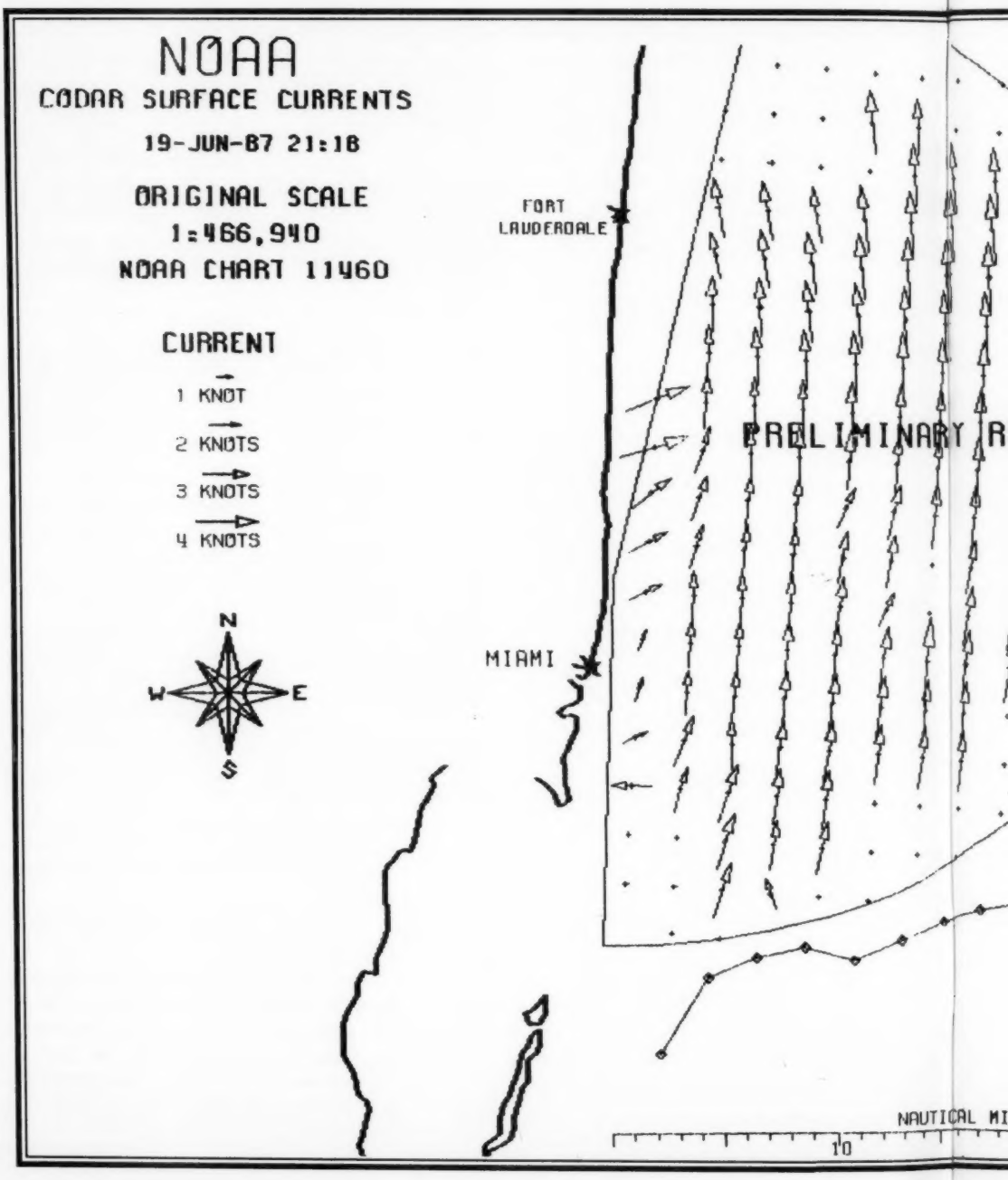
1960 National Oceanographic Data Center established at the Hydrographic Office to acquire, process, preserve and disseminate oceanographic data for military, scientific and commercial purposes.

1962 Hydrographic Office renamed U.S. Naval Oceanographic Office.

1972 Defense Mapping Agency established to direct all mapping, charting, and geodetic functions in the Dept. of Defense. The responsibility for navigational information, charting and distribution were transferred from the Naval Oceanographic Office.

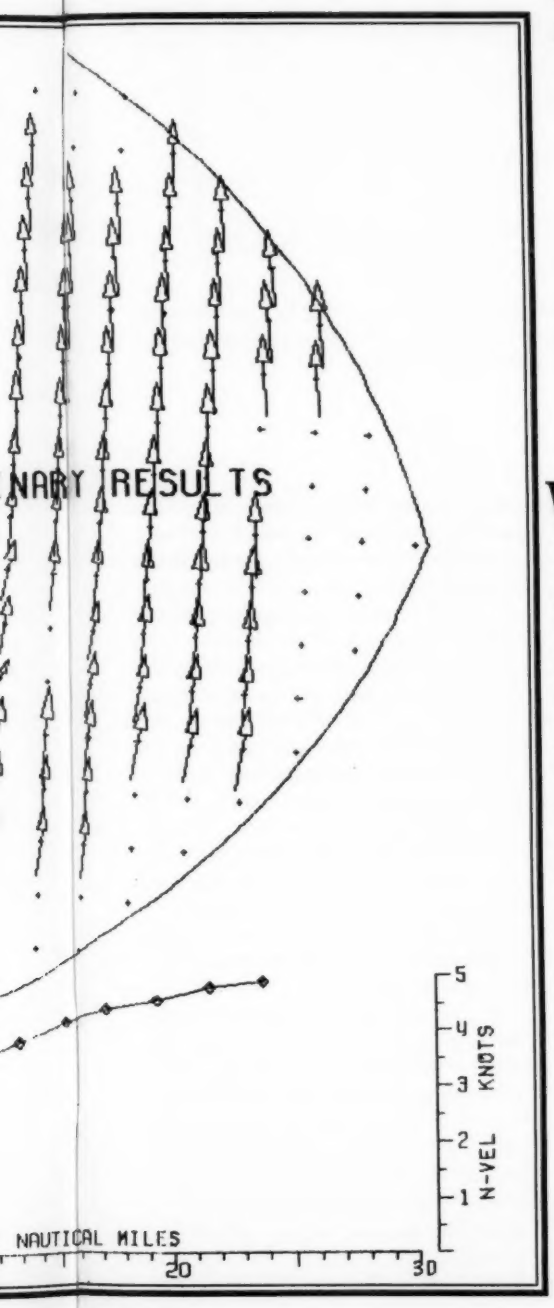
1976 Pilot Chart of the North Pacific published quarterly to allow vessels access to the charts three months in advance of sailing time.

These are real-time surface currents from the NOAA-Coast Guard experiment evaluating surface radar (CODAR) observations in the Straits of Florida. As indicated these represent preliminary results. For additional information contact Dr. George Maul, NOAA/AOML, 4301 Rickenbacker Causeway, Miami, FL 33149.



Surface Currents in the Straits of Florida

— by Robert Molinari
Atlantic Oceanographic and Meteorological Laboratory
NOAA, Miami, FL
and
Kevin Leaman
Rosensteil School of Marine and Atmospheric Science
University of Miami, Miami, FL



Whether attempting to cross or parallel the Gulf Stream, mariners, from day sailors to masters on supertankers, must compensate for the intense surface speeds associated with this current to successfully reach their destination. Frequent Gulf Stream mariners, particularly those without modern navigational devices, have a formula to include in navigational computations. For instance, a favorite for the Miami-Bimini crossing is to steer a course which compensates for a "3-knot Gulf Stream"; they assume that the average northward component of current between Miami and Bimini is 3 knots. Let's take a look at the 3-knot rule.

Regrettably we can not offer detailed instructions for navigation when in the Gulf Stream on any given day. Oceanographers do not have a network of observing systems to measure in real-time the velocity of the Gulf Stream as meteorologists do for winds. The first step in developing such a network, however, is underway. Real-time accurate current information is only available when an oceanographic research vessel is actively collecting data in the region, an infrequent occurrence.

Our data result from a study conducted by oceanographers from the Atlantic Oceanographic and Meteorological Laboratory of the NOAA and the Rosenstiel School of Marine and Atmospheric Science of the University of Miami. Observations were collected in a program to determine the role of the Gulf Stream in modulating the global climate by transporting heat from the tropics to the poles. As a spin-off from this study, surface currents were measured across the Straits of Florida at 27°N (figure 1). These observations are supplemented by data collected at approximately the latitude of Miami by Niiler and Richardson (1973) and Brooks (1979). For brevity, these observations will be referred to as the Bimini data. The 27 N section was occupied from 1982 to 1984 and the 26 N section from 1965 to 1974.

The long-term "approximate location of axis of Gulf Stream" is also shown in figure 1. The axis was derived from ship drift reports (ship drift defined as the difference between course steered and course made good) as provided by mariners to government agencies over many years. Similarly, an average Gulf Stream can be estimated from our data with considerably more detail in space. Average downstream velocity vectors at the station positions are given in figure 1 (we do not consider the

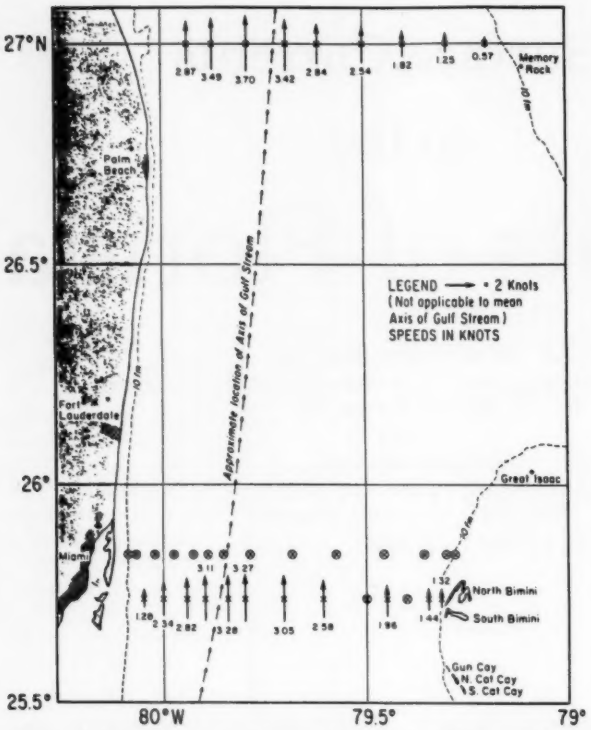


Figure 1. — Current measurement positions over a long period of record for two studies. Also included is the mean annual northward component of velocity in knots at each location and the approximate location of the axis of the Florida Current

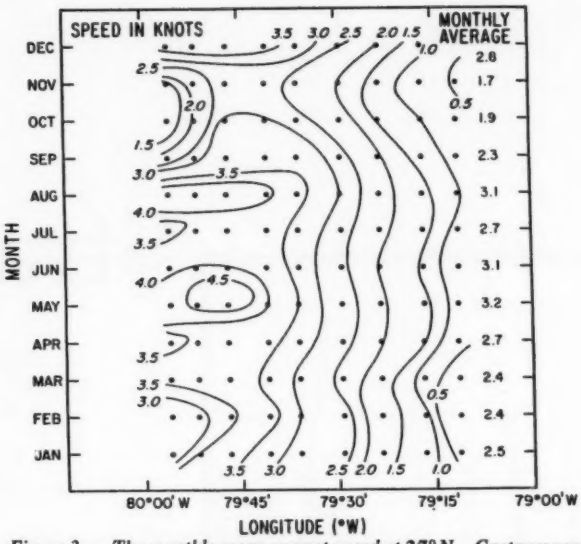


Figure 3. — The monthly mean current speed at 27°N. Contours represent the mean monthly northward component of the Gulf Stream at 27°N as a function of the month and longitude.

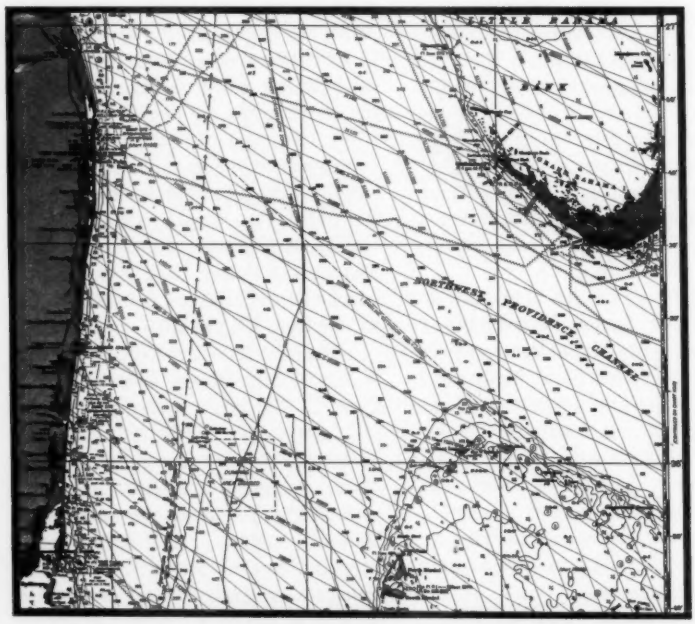


Figure 2. — The area of concern is shown on this portion of NOS Chart 11460.

small cross-stream component). The average vectors at 26°N and 27°N are very similar. There is a characteristic structure to the Stream with distance from the coast of Florida. A rapid build-up in speed takes place from the coast to the axis of the Stream at both latitudes with a gradual reduction to the east. On average, the axis is located some 15 miles offshore.

The average northward surface speed derived from all the data at 26°N is about 2.4 knots and at 27°N, 2.5 knots. In the jargon of oceanographers, the difference between the two speeds is not "significant." The difference is also not significant for most navigators and an average Gulf Stream that can be expected when sailing across the Straits at these latitudes is about 2.5 knots (figure 2).

Next, we consider how the Gulf Stream, on the average, changes with season. We stress "on the average" because the averages are derived from a modest number of data at each position and, as will be shown shortly, there are large changes in surface speeds over short periods of time (days). Thus, it is possible that the few observations available during a particular month were taken at the time of an extreme (either high or low) surface speed and do

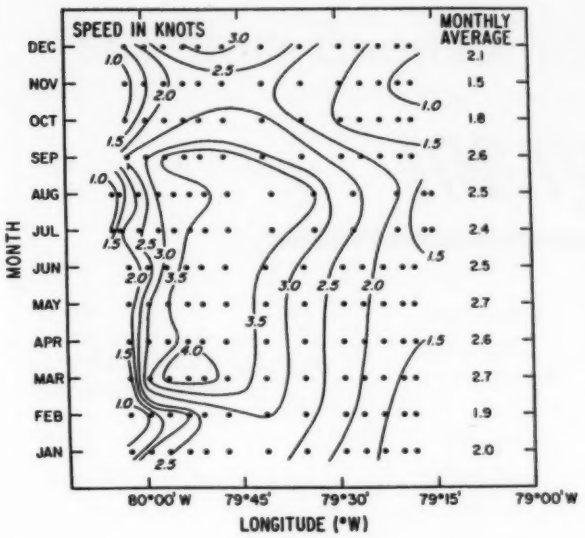


Figure 4.—The monthly mean current speed at 26° N. Contours represent the mean monthly northward component of the surface speed of the Gulf Stream at 26°N as a function of month and longitude.

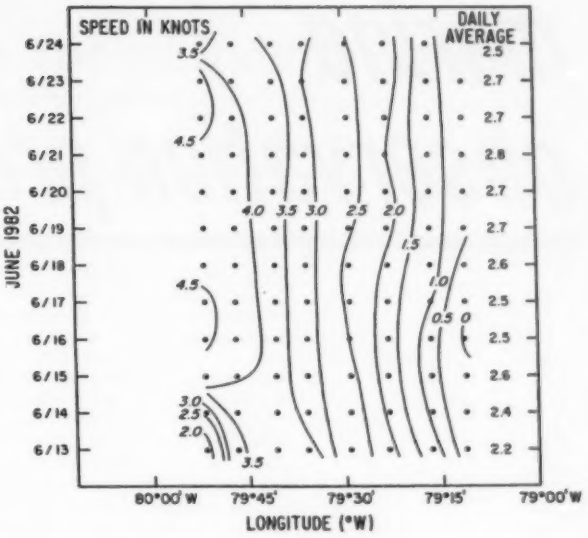


Figure 5.—A 4-day period of currents measured at 27°N during June, 1982. Contours represent the mean monthly northward component of the Gulf Stream at 27°N.

not represent a true average. However, the similarities between the data at 26° and 27 N indicate that the overall picture is correct. Figures 3 and 4 show the mean monthly average speeds at each station. The average speed for each month is given along the border of each figure.

With the monthly average speeds, the differences between the two latitudes are probably not significant. At both latitudes highest average speeds (over 2.5 knots) occur during late spring and summer. Lowest speeds occur during the fall, with the average November reading about 1.5 knots.

In the western Straits, the range of monthly surface speeds is larger than the range in the mean monthly speeds (of particular concern to those navigating along rather than across the Stream). At 27 N, the highest speeds (over 4 knots) were observed in late spring and summer with a maximum in May. Lowest speeds occur in November. The range in speeds from the maximum in May to a minimum in November is over 3 knots at the westernmost stations. In the east, seasonal changes in speed are about 1 knot. The picture is not as clear at 26 N (figure 4). For instance, during February, lowest speeds were observed at the westernmost stations, possibly due to the lack of data available during this month., However, the overall patterns are similar with highest speeds observed during late spring and summer and lowest speeds during the fall.

At 27°N, research cruises were typically about two weeks in length so day-to-day changes were apparent. During many of these cruises, changes within a few days time were larger than the seasonal changes shown in figures 3 and 4. For instance, during June 1982 speeds on the western side of the Straits ranged from less than 2 knots to almost 5 knots over a four-day period (figure 5), similar to the changes between May and November. Fall changes were less dramatic.

These rapid current changes, are believed to have been caused by changes in the wind over the Gulf Stream. However, the present understanding of the causal relation between wind and current variability is not sufficient to predict their occurrence or magnitude. Thus, all we can offer is the observation that the average Gulf Stream speed can change by more than one-half a knot within several days. On the western side of the of the Straits, the changes are most dramatic, approaching 3 knots.

However, there is help on the way, for mariners, in the form of a radar system which can sense current speeds and directions. One such system is being deployed in south Florida by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Coast Guard. The Coast Guard will use the resulting information to assist in its search and rescue operations while NOAA will disseminate the information to the public. Current maps will be available from Miami to Fort Lauderdale, from the coast to approximately 30 nautical miles offshore. The system can provide vectors of surface currents at 3- hourly intervals.

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Brooks, I. H. (1979). Fluctuations in the transport of the Florida Current at periods between tidal and two weeks.
J. Phys. Oceanography., 9, 1048-1053.

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J. Mar. Res., 21, 144-167.

marine observation program

--by Martin S. Baron
National Weather Service
Silver Spring, Md.

New PMO in Houston

Jim Nelson has been selected as the new PMO in Houston, TX. Jim was born in Washington, D.C. and grew up in Kittery, ME, New York City and Hyattsville, MD. He spent 20 years in the Navy and served on destroyers, ice breakers and aircraft carriers. He was at sea for over 9 years. Jim served as a weather observer and forecaster, communications supervisor, computer operator and instructor and worked in the Navy ship visitation program. After retiring from the Navy, he worked at the National Climatic Data Center in Asheville, NC in the surface observations verification unit and taught a basic observing course. Jim joined the National Weather Service in 1984 and worked as a weather radar specialist in Galveston, TX. Jim and wife Elizabeth have four married children and two grandchildren.

New PMO Cards

For acknowledging receipt and thanking ships' officers for their weather observations, we are now using a postcard. The card has room for comments by the PMO regarding the quality and format of the observations. To ensure the delivery of this and other program materials it is requested that you notify your PMO of any change of address.

Jim Nelson, new PMO in Houston, TX.

New Sea State Chart

Charts for estimating wind speed from the state of the sea are now available from the PMO's. The charts contain 12 sea state photos with their probable wind speeds, ranging from Beaufort Force 0 to Beaufort Force 11. All the photos were taken from Ocean Weather Station **P** in the North Pacific, at 50°N, 145°W, during the mid 1970's. Kudos to George Payment, Canadian Marine Meteorological Officer, for providing the photos for the project.

When using the sea state to determine wind speed, look at wave height and length and the quantity and form of whitecaps, spray and foam. As the windspeed increases, sea waves become higher and longer, whitecaps become more numerous, spray appears and then foam will form in well- marked streaks. Force 0, wind speed less than 1 knot, is marked by a complete absence of any sea wave activity. Force 1 and 2, wind speed up to 6 knots, is characterized by ripples or small wavelets less than .3 meters high. Whitecaps generally first appear at Force 3, 7-10 knots, waves .6-1 meter high. By Force 5, 17-21 knots, waves 2-2.5 meters, there are many whitecaps and spray appears. Waves are now noticeably longer in length. By Force 7, 28-33 knots, waves 4-5.5 meters, foam from breaking wave crests is blown in streaks along the wind direction. Force 8, 34-40 knots, waves 5.5-7.5 meters, is marked by very well-defined foam streaks, with wave crests breaking into spindrift. By Force 9, 41-47 knots, waves 7-10 meters, sea spray may reduce visibility. With Force 11, 56-63 knots, waves 11.5-16 meters, the sea is covered with white foam patches and visibility is still more reduced by spray. These descriptions are based on sea conditions over deep water with a fully developed sea. This requires the winds to have been blowing from the same direction for a relatively long time over a sufficiently long fetch.

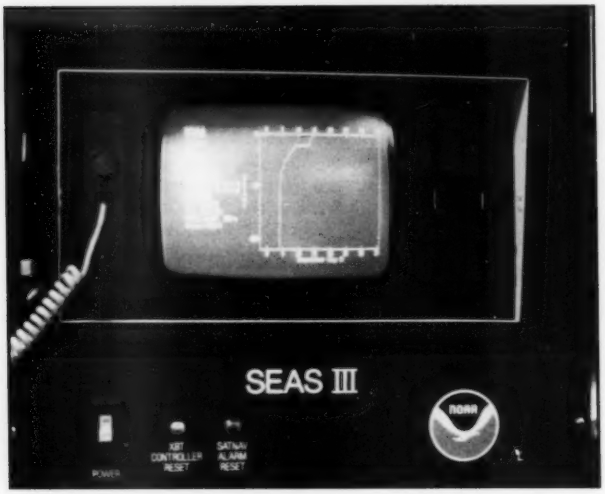
Sea State Chart for Wind Speed Determination

Code Figs. (knots)	Mean	Beaufort	Description	Sea criterion when sea fully developed	Probable ht. of waves in m. Avg.	Max.
01 - 03	02	1	*Light air*	**Ripples** with the appearance of scales are formed, but without foam crests	0.1	0.1
04 - 06	05	2	*Light breeze*	**Small** wavelets, still short but more pronounced, crests have a glassy appearance and do not break	0.2	0.3
07 - 10	09	3	*Gentle breeze*	**Large** wavelets; crests begin to break; foam of glassy appearance; perhaps scattered white horses	0.6	1
11 - 16	13	4	*Modt. breeze*	**Small** waves, becoming longer; fairly frequent white horses	1	1.5
17 - 21	19	5	*Fresh breeze*	**Moderate** waves, taking a more pronounced long form; many white horses are formed (chance some spray)	2	2.5
22 - 27	24	6	*Strong breeze*	**Large** waves begin to form; white foam crests are more extensive everywhere (probably some spray)	3	4
28 - 33	30	7	*Near gale*	**Sea** heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind	4	5.5
34 - 40	37	8	*Gale*	**Modereately** high waves of greater length; edges of crests begin to break into the spindrift; the foam is blown in well-marked streaks along the direction of the wind	5.5	7.5
41 - 47	44	9	*Strong gale*	**High** waves; dense streaks of foam along the direction of the wind; crests of waves begin to topple, tumble and roll over; spray may affect visibility	7	10
48 - 55	52	10	*Storm*	**Very** high waves with long overhanging crests; the resulting foam, in great patches is blown in dense white streaks along the direction of the wind; on the whole, the surface of the sea takes a white appearance tumbling of the sea becomes heavy and shock-like; visibility affected	9	12.5
58 - 63	60	11	*Violent storm*	**Exceptionally** high waves (small and medium-sized ships might be for a time lost to view behind the waves); the sea is completely covered with long patches of foam lying along the direction of the wind; everywhere the edges of the wave crests are blown into froth; visibility affected	11.5	16
64 and over	—	12	*Hurricane*	**The** air is filled with foam and spray; sea completely white with driving spray; visibility very seriously affected	14	—

Obituary

Richard Rasmussen, PMO in Jacksonville, FL, passed away on May 12, 1987. He had been with the National Weather Service for 10 years. He was 51 years old. Richard worked at Huron, SD, Toledo, OH and Key West, FL before becoming PMO at Jacksonville in July of 1983. Previously Richard spent 16 years in the Navy and 4 years in the Air Force. He is survived by his wife, Mary, one son, two daughters and several grandchildren. The entire Marine Observation Program staff is saddened by this loss. We will miss him as will the ships he served. The family address is 8210 Old English Drive, Jacksonville, FL 32244.

This SEAS III unit was provided to the ***Shenehon*** *on March 29, 1987.*



SEAS III Units Installed

The Great Lakes vessels Shenehon and Delaney have received Shipboard Environmental Data Acquisition Systems (SEAS). These systems transmit the weather observations to the NWS via one of the Geostationary Weather Satellites. The observation is manually entered by the observer through a keyboard. The SEAS III version automatically records and transmits Bathythermal (temperature- depth) data. This data will assist with ice forecasting on the Great Lakes.

Chicago PMO presents NOAA patches to the Crew of the ***Shenehon.*** *From left, Bob Collins (PMO), John Grimes (crewman), Captain Dave Morse and Bill Burns (crewman).*

tips to the radio officer

--by Jullie L. Houston
National Weather Service
Silver Spring, Md.

Important Reminder Again!!

Some Ships transmitting OBS via USA CES INMARSAT are neglecting to disconnect the transmitter after sending their observations. This is causing a substantial cost to the National Weather Service (NWS). The NWS limit for an observation is not to exceed two minutes. For example, a ship failed to disconnect its sending equipment after completing the message leaving the transmitter open to 89.0 minutes costing a total of $404.95.

The NWS also reminds ships to use the correct format for Meteorological Surface OBS and Bathythermal OBS. For example:

(1) Bathys should start with **JJXX** and end with the **Call Sign**

(2) Met Surface OBS should begin with the **Ship's call sign** and end with **FIVE PERIODS.**

Interlacing Bathy and Ship Surfaces OBS format in one transmission results in loss of data within the system.

Update

The publication "Selected Worldwide Marine Weather Broadcast" is being reformatted and updated, please send any schedule changes to the following address:

National Weather Service
International Telecommunications
Section W/OS0151 Room 419
8060 13th Street
Silver Spring, MD 20910

~~Free~~

Now Available
March 1987 Edition

– by Elizabeth Anne White

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Pacific Ocean

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Seattle, WA 98102-3767

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the mail bag

This informative letter was sent by **Ray Conrady** a 3rd Mate for the United States Lines:

You are very good at showing us, out at sea, how to make out our weather reports (WS FORM B-81). The only problem is that we are sometimes not too good at dong it the way you tell us.

Just so I'm sure you know, here's some of the tings we do. Perhaps you can reflect on the seriousness of some of our errors:

—**LA & LO** - usually put down one-half hour or so before reporting time.

—**h** - height of cloud - we use the formula (DRY °C - DP °C x 133= ht) and as you know, this doesn't always give a correct estimate.

—**Td & Tw** - we measure to the nearest degree F, use wet/dry thermometers mounted on the wings of the bridge (as opposed to the furnished sling, or electric psychrometer) and if we're conscientious we use the reading on the coolest side of the ship.

—**Vs** - Ships speed- we never are sure what to do if the speed is between 20 and 21 knots.

— **Sea Temp** - we use the temperature from the log book from the end of the last watch (as opposed to calling the engine room & asking for it) so the sea tem can be as much as 4 hours off.

We're never sure what to do regarding wind speed or direction, or cloud type or height when it's so dark that we can't see anything - do we make a vague guess or leave it blank? Also, as you know, we seldom put down transmission details. I have attempted to do this on some ships and the cooperation has always been nil.

These are important points that have been raised and we will have a response from the NWS in our next issue. — Ed.

Hurricane Watch, 1987

January

Australia-S. Pacific
Tusi (8P) H
Connie (10S) T
Irma (11P) T
Damien (12S) T

South Indian
6S T
7S T
Alinina (9S) H

W. North Pacific
Orchid (1W) H

February

Australia-S. Pacific
13P T
Uma (14P) H
Jason (15P) H
Veli (16P) T
Elsie (18S) T
19P T
Wini (20P) T

South Indian
Clotilda (17S) T

North Indian
01B T

March

Australia-S. Pacific
Yali (22P) T

South Indian
21S T

April

Australia-S. Pacific
Kay (23P) T
Zuman (25P) T

South Indian
24S T
26S T

W. North Pacific
Percy (2W) T

May

Australia-S. Pacific
Blanche (27P) T

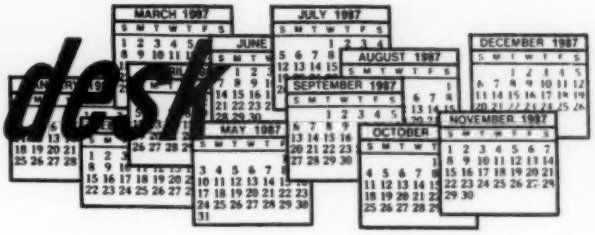
North Atlantic
Td 1 D

June

E. North Pacific
Adrian T

North Indian
02B T
03A T

the editor's desk



Global Wave Statistics

This is a book compiled by BMT Ltd in collaboration with the United Kingdom Meteorological Office. It serves as one more example of the multitude of uses made of ship weather observations.

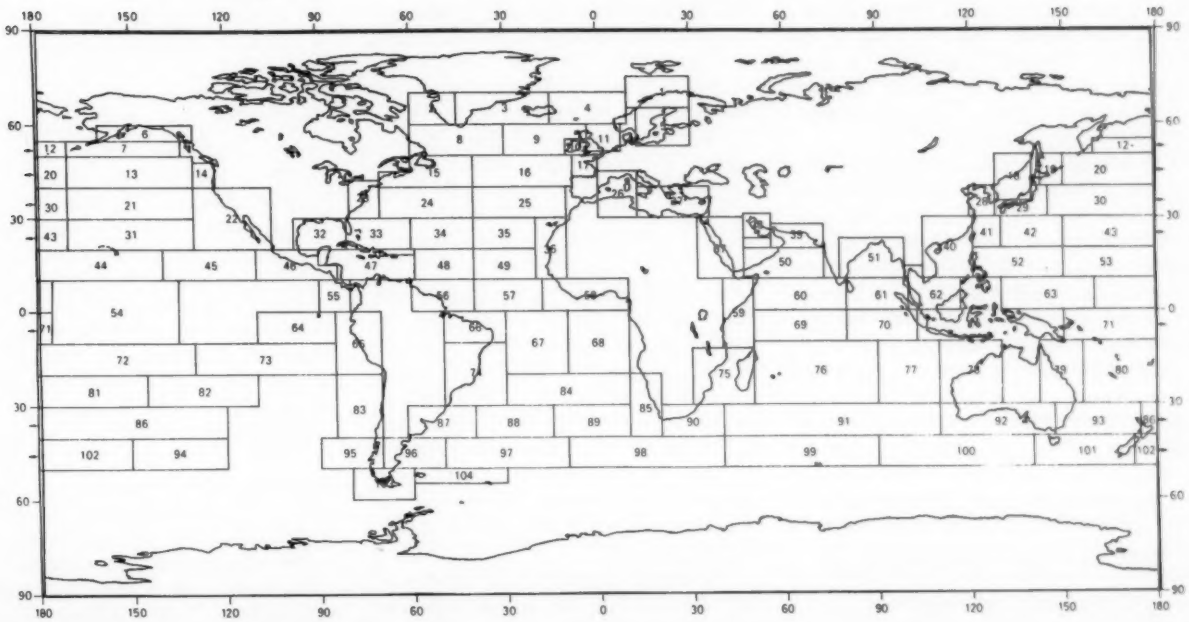
The data have been derived by a quality enhancing analysis of a massive number of visual observations of both waves and winds reported from ships in normal service all over the world. This technique uses a computer program called NMIMET. Although the statistics presented relate only to waves, the NMIMET Analysis technique makes use of the wind observations to imporve the reliability of wave statistics. It derives reliable statistics of wave period by an analytical modelling of the joint probability distribution of heights and periods.

A forerunner of this book entitled Ocean Wave Statistics was published in 1967 and contained unprocessed frequency distributions of visually observed wave heights, periods and directions for 50 sea areas. It is out of print.

To achieve good glogal coverage within a book of reasonable size it was necessary to subdivide the data into relatively large areas. However, the NMIMET analysis can be used to provide data for much smaller areas and this service is available for further information write:

Global Wave Statistics
Unwin Brothers Ltd
Old Wokins
Surrey GU22 9 LH
England

Map of Area Subdivisions



beyond the rainbow

--by William R. Corliss
P.O. Box 107
Glen Arm, MD 21057

" Unusual natural phenomena at sea "

Many mirages are associated with the sea. Landfalls and other ships are seen long before they actually poke above the horizon. Inverted ships and shorelines, frequently distorted and even multiplied, are rather common. Good mirages also appear over land. Flat plains, deserts and ice fields are the best places to hunt for these atmospheric apparitions. The most common mirage of all is that seen in the air just above a hot road surface. But let us talk of less mundane things: great but nonexistent cities in the sky, lateral mirages, reflection mirages, and other atmospheric mirages that are hard to explain.

Mirages sometimes display highly magnified scenes. Islands and cities, hundred of miles away and well below the horizon, appear larger than life in the sky. To magnify in this fashion, the atmosphere must behave like a lens--several lenses in the case of multiple mirages. Just how magnifying air lenses are formed, how they persist so long, and how they create such sharp images when the atmosphere is constantly changing; all are puzzles to the meteorologist. While some mirages are fuzzy and blurred, others show distant scenes with great clarity, just as one might see through rigid, precisely ground glass lenses. Just as in the cases of binoculars and telescopes, the mirage lens often focuses its image in a very restricted area. Moving one's head up, down, or sideways a few feet may destroy the image. Lateral mirages also tax the science of meteorological optics because they require the formation of edge-up layers of air possessing different densities. Gravity should quickly destroy these unstable structures. Yet, lateral mirages are rather common, with as many as nine replications of a scene stacked up side-by-side.

" But let us talk of less mundane things: great but nonexistent cities in the sky ..."

One of the strangest of all mirages--one that seems almost impossible to meteorological optics--is the mirror or reflection mirage. Several observations exist where a scene is apparently reflected in the sky as if some giant mirror had been erected, with the observer located between the real object and the reflected image. These images are not like the shadowy Brocken Specters but well-defined images.

Making the problem more complex is the tendency of the human mind to embellish what the eye sees. These psychic aspects may help account for the fatantastic visions of armies in the sky, unidentified cities, fair, idyllic countrysides and ghost ships plying foggy seas. Just how much does the human mind add to these scenes?

FATA MORGANA

The Fata Morgana is the magnification, multiplication, and gross distortion of distant rocks, ice, and other natural objects so that they appear superficially like buildings, armies, pastoral scenes, etc. The classical Fata Morgana is seen over the Strait of Messina, Italy. The notorious Silent City of Alaska, appearing regularly over Muir Glacier in Alaska, is also a Fata Morgana derived, from ice formations.

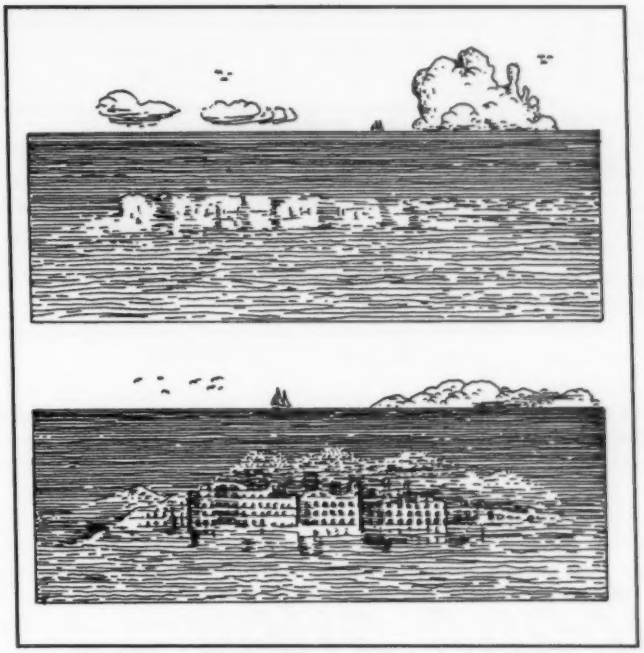
The term Fata Morgana derives from Morgan la Fey, the enchantress from Arthurian legends. Visions of her undersea city were believed to lure seamen to their deaths.

Fata Morganas appear in many parts of the world; but very few scientific studies have been found, especially in recent years. Like the will o' the wisp, no one doubts their existence, but neither does anyone want to study them carefully.

A curious facet of the Fata Morgana phenomenon is the tendency of some observers to see cities, people, grazing

flocks, great armies, and all sorts of fantastic images. Objective scientific accounts differ greatly from popular descriptions. In some respects the situation resembles that in UFO research in that bizarre things seem to be read into the commonplace phenomena. If all Fata Morganas are truly only optical distortions of rocks, ice, etc., there is little that is anomalous.

Much of what is seen in Fata Morganas can be blamed on abnormal refraction distorting natural, everyday objects. It is the human observer who creates people, animals, and other objects from the hints in the distorted images. This human trait is anomalous in itself.



Development of the Fata Morgana over the Strait of Messina.

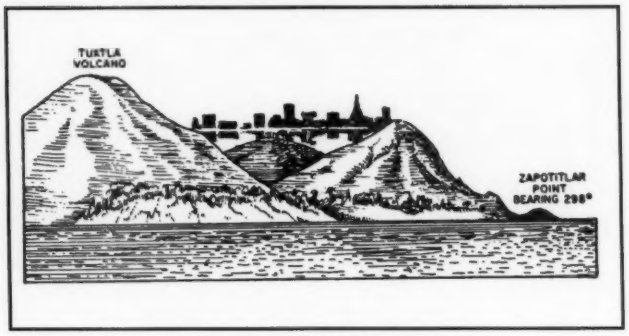
A descriptive example was reported at the mouth of the Firth of Forth, Scotland back in 1871. " During the past week especially, scarcely a day has passed without exhibiting extraordinary optical illusions in connection with the surrounding scenery, both at sea and on shore. As an instance of the unusual nature of these phenomena, the whole of the Broxmouth policies, mansion-house, and plantations, were on one day apparently removed out to sea . One of the finest displays of mirage, however, occurred on Saturday afternoon. The early part of the day had been warm, and there was the usual dull, deceptive haze extending about half-way across the Firth, rendering the Fife coast invisible. The only object on the Fife coast indeed, which was brought within the range of the refraction was Balconic Castle on the "East Neuk," which appeared half-way up the horizon, and in a line with the Isle of May. The most extraordinary illusions, however, were those presented by the May island, which, from a mere speck on the water, suddenly shot up in the form of a huge perpendicular wall, apparently 800 or 900 feet high, with a smooth and unbroken front to the sea. On the east side lay a long low range of rocks, apparently detached from the island at various points, and it was on these that the most fantastic exhibitions took place. Besides assuming the most diversified and fantastic shapes, the rocks were constantly changing their positions, now moving off, and again approaching each other. At one time, a beautiful columnar circle, the column seemingly from 20 to 30 feet high appeared on the outermost rock. Presently the figure was changed to a clump of trees, whose green umbrageous foliage had a very vivid appearance. By and by the clump of trees increased to a large plantation, which gradually approached the main portion of the island, until within 300 or 400 feet, when the intervening space was spanned by a beautiful arch. Another and another arch was afterwards formed in the same way, the spans being nearly the same width, while the whole length of the island, from east to west, seemed as flat and smooth as the top of a table. The best examples always seem to involve images of men, animals, trees, etc.

Another example of the Fata Morgana has been observed on the Muir Glacier, in Alaska. This report, on the "Silent City of Alaska" appeared in the Victoria Daily Times, January 26, 1901: "It is said to appear every year on the gigantic glacier of Mount Fairweather. This phenomenon has engaged the attention of scientists, and to the present time it has baffled all investigation. The scene has been known to the Alaska Indians of the locality for generations, and has been a common subject of speculation among them. The photograph was shown to some Alaska Indians by Capt. Foot of the *Danube* who brought it down to Capt. Walbran, and they instantly recognized it as the famous city in the clouds. The phenomenon is seen between 7 and 9 o'clock between June 21 and July 10, and the scene never varies excepting for slight changes in the buildings and other prominent landmarks. It is believed that the mirage is a representation of the city of Bristol , England. That it is a seaport is shown by the mast of a vessel, while a tower, an exact duplicate of that of St. Mary Redcliff, appears in the backgound. The earthquake of last year broke up the Muir glacier over which the route to the mountain lies. It is a distance of about 15 miles from Muir glacier bay to the scene of the phenomenon. A scientific party from San Francisco will investigate it next May. The distance between Bristol and Mount Fairweather is about 2500 miles. The longest distance a mirage has been seen hitherto is 600 miles."

February 14, 1936. Gulf of Mexico, North Atlantic Ocean. 1:05 to 2:10 p.m. "Observed two mirages, No. 1 bearing 018° and No 2 bearing 294° . Ship's course 325° . The appearance of a fog bank lay on the horizon, the angular height of which was 2° 10' . The mirage to seaward, No. 1 (not reproduced), was directly opposite the sun, and slowly opened its bearing on the starboard bow, as the sun altered its bearing. This mirage was visible for 1 hour 5 minutes it maintained the same appearance throughout, and always bore directly opposite the sun. It appeared as two headlands forming an entrance to a bay or harbour, and trees were clearly visible, also hills in the background. The fronts of these headlands were a sandy colour. When this mirage commenced to disapp-

ear it rose up from the horizon, and became fainter, until when it reached the top of the fog bank it disappeared instantly. The fog bank cleared away 9 minutes later.

The other mirage, No. 2, was over the land and appeared between two mountains, it was visible from 1.05 p.m., until 1.24 p.m., and appeared as a harbour, surrounded by large buildings, some of these buildings were inverted and appeared to resemble reflections of the other buildings. As this mirage disappeared, it changed its appearance, becoming narrower, until it was only two dark lines in the sky, separated by a white line. The white line was visible all the time, and separated the inverted buildings from the upright buildings."



Fata Morgana seen in the Gulf of Mexico

The Yucatan Peninsula was some 200 -- 300 miles east of the ship, raising some possibility that mirage No. 1 might be a telescopic mirage. It cannot be a Fata Morgana because there is no shoreline from which to create distorted images.

hurricane alley

hurricane alley

Note

The Worldwide tropical cyclone tracks for Jan., Feb. and Mar. will appear in the next issue since the JTWC, our usually reliable data source, is suffering from a shortage of manpower, or womanpower as the word has it.

Tropical Cyclone Sally
Dec. 26 1986 - Jan. 5, 1987

Satya Kishore

Sally was the second intense tropical cyclone or the 1986 - 1987 season. It spawned from a trough of low pressure to the southwest of Puka Puka in the Northern Cooks and moved rapidly towards the southeast. Sally then curved to the south before slowing down and executing a loop over an area to the north of the Southern Cooks. After affecting the islands of Palmerston and Aitutaki in the Southern Cooks with a prolonged periof of gale to storm force winds, it accelerated and passed almost directly over Rarotonga. The cyclone then gradually curved towards the east and weakened, passing to the south of the Austral Islands and bringing a very brief period of gales to the island of Rapa (fig 1).

Sally's intensification was very rapid. It developed from a depression with gale force winds into a tropical cyclone with hurricane force winds, of about 75 knots, within 36 hours, and it retained hurricane intensity for about six days. Its well defined eye remained visible most of the time during this period.

Sally caused considerable damage to the Southern Cooks, the cost of which was estimated to be over 30 million New Zealand dollars. Rarotonga, Aitutaki and Palmerston suffered extensive damage to houses, coconut trees and other vegetation. The rest of the islands in the Southen Cooks also experienced damage to wharves and coastal areas from high seas and heavy swells.

The maximum winds and lowest pressures reported by some stations during the height of Sally are shown below.

Tropical Cyclone Tusi
Jan. 15-21, 1987

Michael R. Laidlaw

Cyclone Tusi was a small tropical cyclone which intensified rapidly to hurricane force during the 18 hours before it passed over the Manu'a Islands in American Samoa. At Pago Pago only 70 miles west of Tusi's track, winds did not reach gale force. Although there were no meteorological obs-

STATION	MAX WINDS (KNOTS)	MAX GUSTS (KNOTS)	MIN SEA LEVEL PRESSURE (Mb)
Palmerston	70 29/1500-1800	100 29/1500	993
Aitutaki	47 02/0500-0700	70 02/0600 & 0800	983
Rarotonga#	60 02/2300	83 02/1400 & 1500	967
Mangaia*	75 03/0300-0430	95 03/0300	986

* Winds considered overestimated by 20-30 knots
# Anemograph may register 5-10 knots below true speed.

ervations close to of the centre, the widespread devastation in the Manu'a Group and the appearance of an eye in satellite imagery confirm that the cyclone reached full hurricane force (fig 2).

Tusi started on the 13th as a small depression near Tuvalu within an active trough extending from Tuvalu to the Southern Cook Islands. The depression slowly deepened, and the associated cloud became organized into a circular central cloud mass with cloud bands extending to the northeast and southwest. By 0000 on the 16th the cyclone, near Tokelau, was sufficiently well organized to be named Tusi.

Initially the system moved slowly southeastward along the trough between Fakaofo and Swains Island. On the 17th it started moving southwards towards American Samoa at about 5 knots. By 0600 the cyclone was estimated to have intensified to storm force. It continued to intensify, developing an eye visible on satellite imagery and hurricane force winds by 1600. Tusi then moved toward the southeast at 10 knots to reach the Manu'a Islands in American Samoa around 0300 on the 18th.

Samoan newspapers report that only two people of the 2000 inhabitants of the Manu'a group were seriously injured and none killed. According to the Samoa News of January 20th, of the 300 houses, churches, schools, stores and other buildings in Manu' a, 100% of these buildings were destroyed in Faleasao, Fitiuta and Sili, Ofu and 50% in Olosega.

Tracking and estimating the intensity of Tusi was hampered by the lack of observations. For much of its lifespan Tusi was not close enough to land stations to provide surface observations which could help to determine the position of the centre with greater accuracy.

The damage caused in the Manu'a Group and the small eye visible in satellite imagery are consistent with the forecast speed of 75 knots (10 minute average) and 100 - knot gusts.

Tropical Cyclone Uma February 4-11, 1987

Pradeep Kumar

Tropical cyclone Uma originated from a very active convergence zone close to Rennel Island in the southern part of the Solomons group. Unlike many tropical cyclones, which remain weak and slow-moving during the initial stages of development, Uma intensified rapidly, from a shallow depression, and attained gale intensity in about 24 hours. It moved southeastward through its entire lifetime with different speeds (fig 3).

Uma attained hurricane intensity on the 6th of February just west of Espirito Santo in northern Vanuatu. At its peak intensity, Uma is estimated to have attained a 10-minute average wind speed of 90 knots with gusts up to 120 knots. The cyclone was weakening as it crossed the central and southern islands of Vanuata.

At the time of writing this report, very little information was available on the actual conditions experienced in Vanuatu during the passage of Uma but very severe damage has been reported. Uma appears to

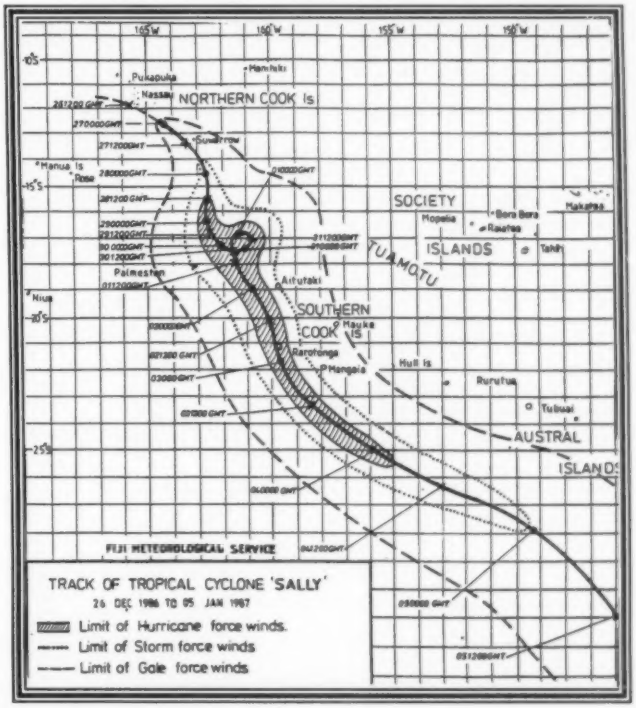


Figure 1. — Tropical Cyclone Sally

have had winds of 80 knots with gusts up to 110 knots when it affected Efat'e , the island on which the capital Port Vila is sited. The cyclone is estimated to have passed about 30 miles to the west of this island. Erromango, Tanna and Aneityum experienced marginal hurricane or storm force winds. Efat'e was the most severely affected since it appears that the eye wall of the cyclone, which contains the strongest winds, passed across the island. The lowest pressure recorded at Vila was 957 mb with maximum winds estimated at more than 75 knots. Uma left about 50 people dead and close to 15,000 people homeless. The total damage to the country was estimated to be 150 million dollars.

Uma was closely followed by another tropical cyclone named Veli. During the decaying stages, these two systems merged to form a complex low and maintained winds of gale intensity till the 11th. There

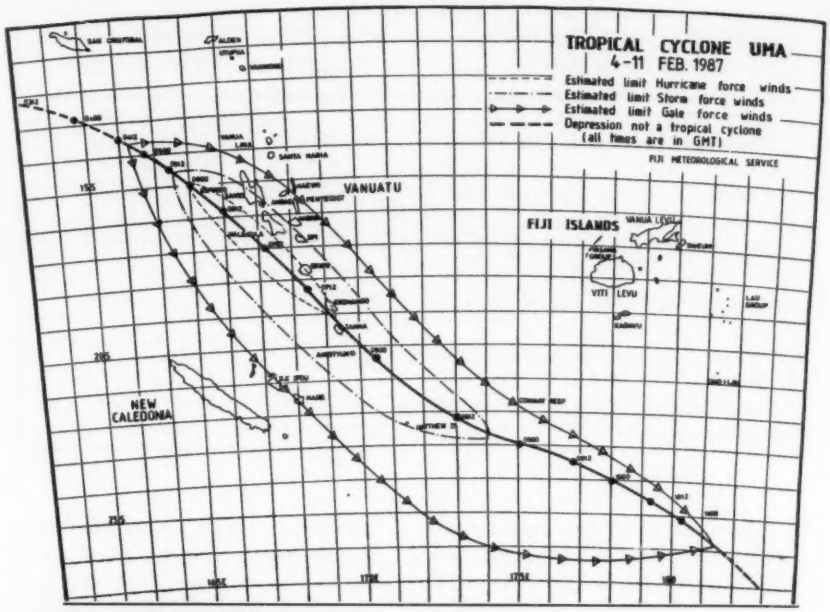


Figure 3. — Tropical Cyclone Uma

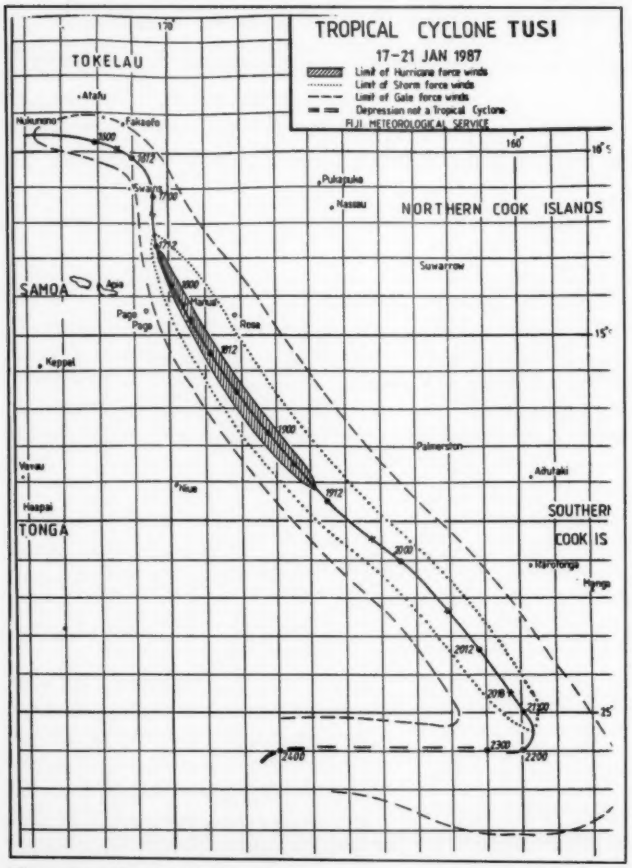


Figure 2. — Tropical Cyclone Tusi

is some uncertainty regarding the path of Uma from the 9th onward since it became very difficult to locate its centre during this period.

Tropical Cyclone Veli
Feb. 6-11, 1987

Ms. Sudha Singh

On February 6th a shallow depression began developing in the Coral Sea south of the Solomon Islands. It moved very rapidly eastward and then southeastward, passing close to Santo in the Vanuatu Group on the 8th. It slowed to the west of Fiji, by the 9th, and later combined with the remnants of tropical cyclone Uma, to form a large low pressure area. It was a small fast-moving system with maximum winds estimated to be about 45 knots and since its track was almost entirely over the ocean, no reports of any damage directly due to cyclone Veli were received (Fig 4).

Veli began as a shallow depression over a large ocean area, about 35 miles south-west of Honiara in the Solomon Islands, late on 6th. It was a small system at this stage. At this time the full-fledged tropical cyclone Uma was located about 600 miles to the east and already causing storm force winds over Vanuatu. For the next 18 to 24 hours the depression moved eastward at

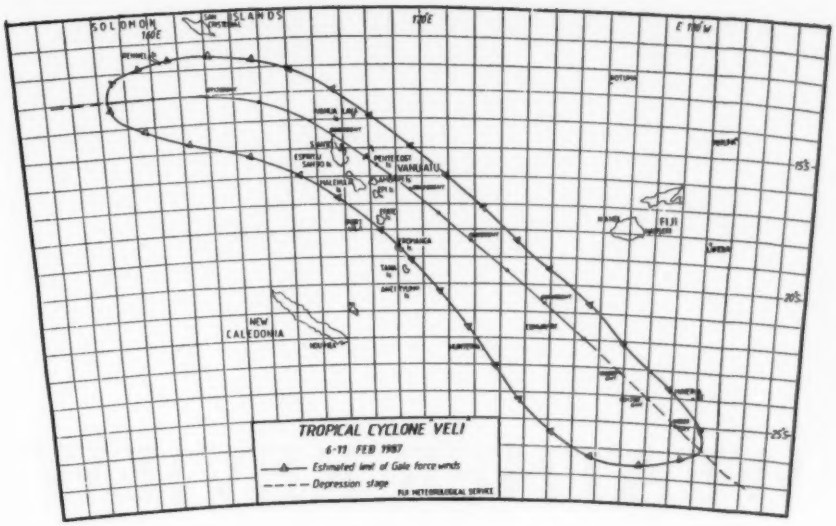


Figure 4. — Tropical Cyclone Veli

centre. Yali then weakened with similar rapidity having maintained hurricane intensity for about 12 hours only.

Yali did not pass close enough to cause damage to any inhabited islands. It was faily compact system and its characteristics were much like tropical cyclone Osea, which had formed earlier in this season. Although synoptic reports from the stations in Vanuatu and New Caledonia indicated the presence of an area of low pressure in their vicinity, it would have been almost impossible to discern the intensity of Yali based on these reports alone and had satellite imagery not been available, it would probably have escaped detection.

about 15 to 20 knots. By 1300 on the 7th, the system was named Veli on the basis of satellite derived evidence. By 0000 on the 8th it passed very close to Santo in Vanuatu and from then on it began moving steadily southeastward. At this stage strong upper northwesterlies caused vertical shear in both tropical cyclone Veli and cyclone Uma and thus weakened them.

After 1200 on the 9th, the remnants of cyclone Veli and cyclone Uma slowed and combined to form a broad complex low pressure area to the southwest of Fiji. As both systems continued moving slowly southeastward, they weakened further and became extratropical over cooler waters.

Tropical Cyclone Yali
March 8 - 11, 1987

Satya Kishore

Tropical cyclone Yali developed about 300 miles to the northwest of Vanuatu on the 5th. It remained as a shallow depression for about three days as it drifted southward before rapidly developing into a tropical cyclone. It is estimated to have acquired its peak intensity around 0900 on the 9th, with maximum sustained winds of 65 knots, close to the centre, and the radius of gales extending to about 120 miles from the

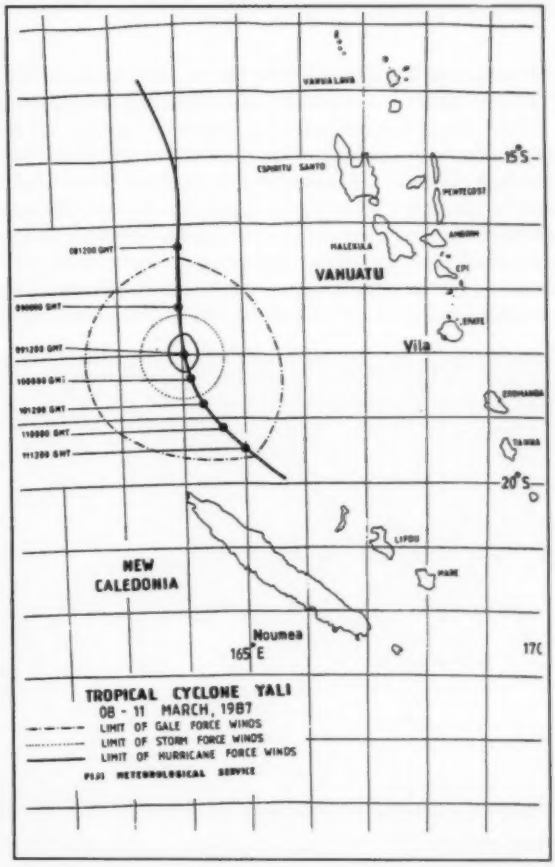


Figure 5.—Tropical Cyclone Yali.

MARINE WEATHER REVIEW

January 1987 - There was a noticeable lack of storm activity over the eastern North Atlantic and the Norwegian and Greenland Seas. This was due to the westward push of Siberian Anticyclone, both at the surface and the 700 mb level. This protective dome (fig 1) inhibited cyclone movement, but you don't get something for nothing. The Siberian High was composed of some pretty frigid air, which created problems both at sea and throughout Western Europe. The system produced a +15-mb anomaly between Scotland and Iceland. The worst of the cold weather occurred around the middle of the month (9th -18th), and it was accompanied in many areas by snow. On the French Riviera vacationers woke up to snow on the palm trees. It was cold in London - how cold was it? It was so cold that Big Ben's bells donged when they should have dinged. In Czechoslovakia wild boars and wolves ventured out of frozen backwoods in search of food. Record low readings included a-31° F in Leningrad, - 11°F in Stockholm and 14°F at the Mediterranean port of Marseilles. Not including the Soviet Union and Poland, newspaper reports have put the death toll at 59. In south Yorkshire Gertrude Reddington, an 87- yr old retired British post mistress was found frozen to death in the snow; a can of birdseed lay next to her body.

To the south in Italy the cold wave caused high seas and strong winds. Airports closed in Naples, Venice, Bologna and on the island of Sardinia. Naples closed its port because of damaged ships blocking the harbor.

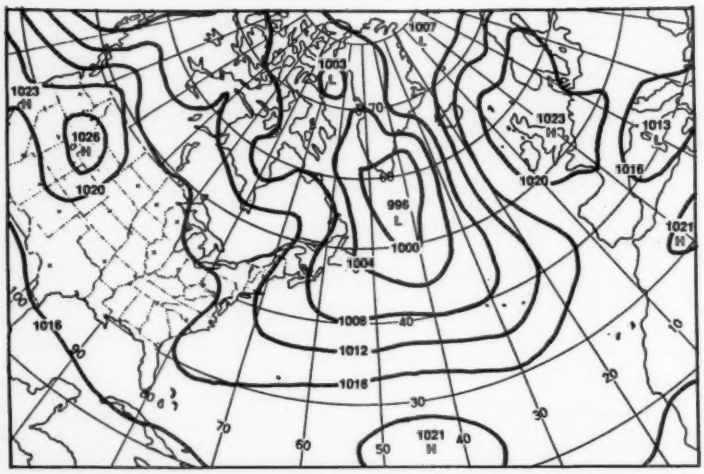


Figure 1.—The month of the Siberian High.

On this date — January 18, 1887 — A luminous snowstorm occurred in Vermont and New Hampshire. St Elmos fire appeared as static discharges on roof peaks, fence posts and hats and fingers of people.

Extratropical Cyclones - The new year began with a howling northeaster along the East Coast of the U.S. The month

The Weather Logs combined with the cyclone tracks, U.S. Ocean Buoy Climatological Data, gale and wave tables and mean pressure patterns provide a definitive report on the primary storms that affect the North Atlantic and North Pacific Oceans. The Monster of the Month is a title given to an extratropical storm that may have been particularly hazardous to shipping. All storms are dangerous! Unless otherwise stated, winds are sustained and time is GMT.

North Atlantic Weather Log
January, February and March

closed with some rough weather over the Mediterranean. In between storms were either shunted to the north or south by the high pressure that dominated Europe and the western North Atlantic for a good part of the month.

✹

This system developed in late December but came to life over northern Florida on the 1st. It moved northeastward and developed within the friendly confines of the Gulf Stream. On the 2d (40°N, 69°W) the ***Chelsea*** ran into 50 - kn southwesterlies in 30-ft seas. The vessel was just south of the storm's center and the wave slope was estimated at about 1/7 — steep. At 0000 on the 3d the ***Irving Arctic***, about 160 mi east northeast of the center reported 45-kn winds in 16-ft swells. Later in th e day the ***Endeavor***, well south of the center, was raked by 48-kn westerlies in 30-ft swells.

Along the New England coast the storm, accompanied by high tides from a rare celestial alignment, pushed 15-ft seas over sea walls (fig 2), swallowing roadways and flooding basements. This alignment of the sun, moon, and earth, occurs about every 18yr. At least five storm- related deaths were reported across New England and up to 18 in of snow were dumped on some

Boston Globe

Figure 2. — Storm waves breach the sea wall at Minot Beach, Scituate, MA.

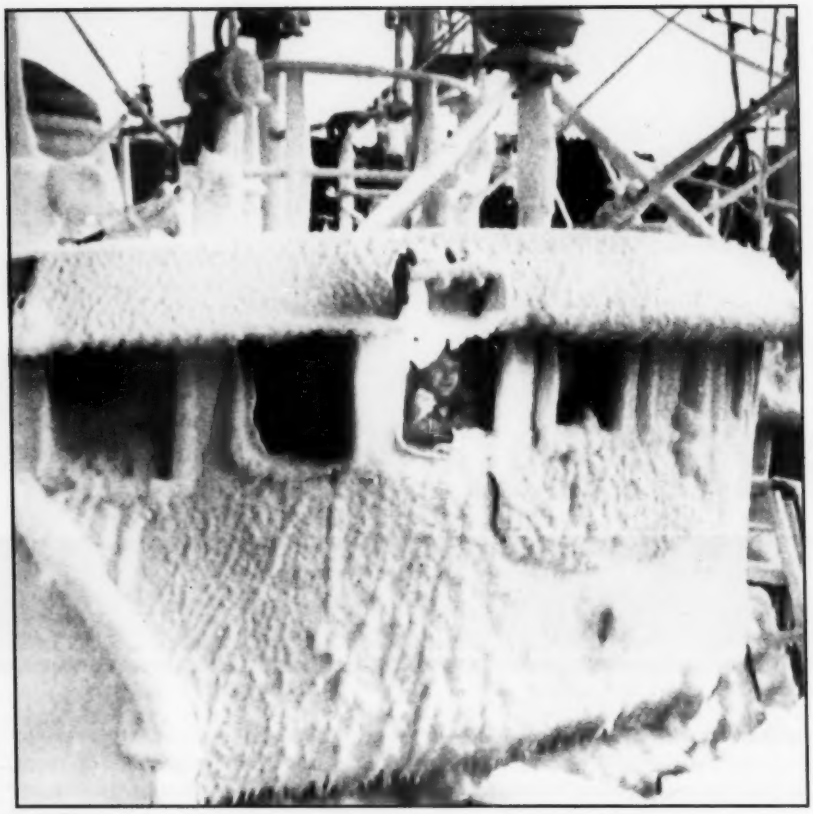


Figure 3.—A Danish fisherman looks from the bridge of his iced-up fishing vessel moored at Kristiansund, Norway.

communities.

Once into the Gulf of Maine the system swung abruptly eastward and then turned northward on the 4th. Winds continued to blow at near storm force until the 7th..

✹

While the previous system was raking the Grand Banks with gales, on the 4th, this storm was providing some rough weather in the North and Norwegian Seas. It had developed on the 2d, south of Greenland, and had moved northward but its 978-mb center was now heading eastward across Iceland. By 0600 on the 4th the ***Sigurour Palmason*** about 300 mi northeast of the center encountered 52-kn easterlies. Six hours later its storm report was added to by vessels off England and rigs in the North and Norwegian Seas. Winds ranged from 45 to 55 kn and swells up to 30 ft were reported. The observers included the ***Cete D' Azur***, ***Salmon Pool*** and the ***Dyri Omega***. On the 5th the system moved into Norway (fig 3).

✹

Early on the 11th a low developed just east of New Jersey. It intensified quickly as it moved northeastward across Cape Cod and through the Gulf of Maine. Its central pressure was estimated at 959mb by 1200 on the 12th, just off Nova Scotia. At that time the ***Dart Americana***, 300 mi to the south, hit 55-kn westerlies in 33-ft seas with a slope of about 1/15. six hours later the ***Bakkatoos***, near 41°, 59°W, encountered 60-kn westerlies, while nearby the ***Maria Gorthon*** reported 55-kn winds in 16-ft swells. The storm swung across Newfoundland and into the Davis Strait on the 14th.

✹

A short-lived storm, on the other side of the ocean, also came to life on the 11th, near 44°N, 29°W. It developed quickly. Pressure on the 12th at 1200 was estimated at 978mb. An ELBZ vessel near 44°N, 30°W, at this time, encountered 60-kn winds from the northwest in swells running 20 ft. The VPGR near 43°N, 27°W hist 52-kn northwesterlies, also in 20-ft swells. The storm headed southeastward approaching the Gibraltar St on the 13th. At this time the system extended eastward across the Mediterranean. Near the Gulf of Lion a secondary center formed and on the 14th became dominant. As this storm drifted eastward it left some weather problems in its wake as mentioned in the casualty reports. In addition the combination of gradients between this storm, a large high over Europe and a slow moving low in th Denmark St (fig 4), created rough weather conditions off Spain and Portugal (see casualty reports).

✹

Toward the end of the month a storm sprung up just south of the Azores. It moved northward and central pressure dropped to 978 mb on the 24th, before crossing through the islands (fig 5). The ***Fritz Reuter*** (39°N, 29°W) ran into 47-kn northerlies at 0000 on the 25th in 20-ft swells. The ***NS - Alliance*** encountered 48-kn south southwesterlies near 32°N, 14°W. The ***Achilles*** was blasted by 56-kn northwesterlies in 16-ft swells, at 1200 on the 26th. The ***Novo-Altaisk*** reported 45-kn winds some 400 mi east of the storm center. The system turned a counter clockwise loop on th 28th and the following day moved ashore over northern Spain.

Tropical Cyclones — There has only been one recorded tropical storm since 1871 in January. That occurred in 1978. No activity was spotted this year.

Casualties — The 300-ton Panamanian freighter ***Donna Nancy*** was pushed into a sea wall at Miami Beach on New Year's Eve by the first described storm. On the 10 th and 11th heavy seas and gales were responsible for the sinking of the ***Regina Maris*** at the port of Maratea, Protenza (Italy). In Naples a breakwater was damaged by vessels, which broke mooring. On the 3d a foreign seaman, fell off the ***Sabie***, which was anchored at Southwest Pass in the Gulf of Mexico. The Coast Guard search was hampered by 28-kn winds and 8-to10-ft seas. No trace of the seaman was found. In the Baltic on the 9th the DRAU

Figure 4.—This system caused some problems to shipping (Jan 12 at 1330).

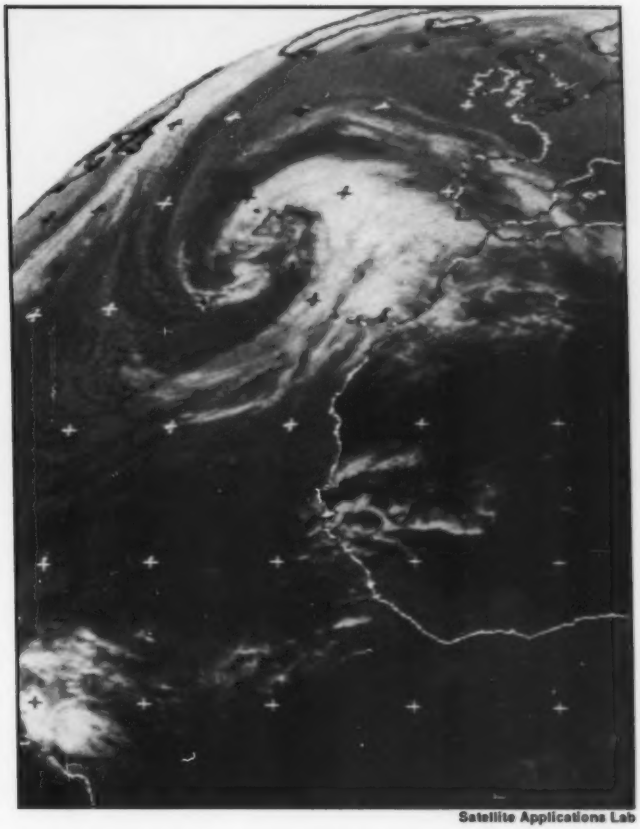


Figure 5.—The large view on the 24th at 1300.

had to call at Mariehammn as it was covered with ice. The ***Cathy Sea trade*** was last heard of on the 14th off the Canary Islands. It is reported that her disappearance was probably the result of bad weather. She carried crew of 27. The ***Testarossa*** was believed to have sunk off Portugal around the same time, with a crew of 30. She reported serious flooding on the 13th, 180 mi off Cape St. Vincent but was not heard from again. On the 17th the Kyretha Star sent out a distress call before sinking 72 mi east of Barcelona. Two of its crew of 20 were rescued. It appears that the vessel sank as a result of cargo shifting in heavy seas. On the 19th the ***Austral Rainbow*** from Lisbon to Norfolk sustained heavy weather damage. The Producer suffered heavy weather damage on the 14th and 15th in the Mediterranean. The ***Ghat*** was damaged when she encountered heavy weather on the 25th lying in anchor in Tripoli, Winds reached force 10.

February 1986— A larger- than- life Icelandic Low dominated the shipping lanes. The 994-mb center east of Newfoundland was 13 mb lower than normal, reflecting the intense cyclonic activity over the North Atlantic (fig 6). Adding to this intensity was a slightly stronger than normal subtropical high, centered near the Cape Verde Is, which served to strengthen the pressure gradient. In the steering level, at 700 mb, this Icelandic Low was also dominant, so the storm movements tended to run generally easterly from North America, swinging toward the northeast near mid ocean.

On this date—February 11, 1951—The greatest ice storm in U.S. history produced glaze up to 4 in thick from Texas to Pennsylvania. It caused 25 deaths, 500 serious injuries and $100 million damage. Tennessee was hardest hit. Communications and utilities were interrupted for a week to ten days.

Extratropical Cyclones — It was a rough month for traffic over the northern shipping lanes. Opening with a short-lived vicious storm from the preceding month, near 50° N, 35°W, rough weather continued throughout. Several systems formed either in the Gulf of Mexico or off the U.S. East Coast and ended up in the waters near Greenland. Some made it into the Mediterranean where activity was greater than normal.

●

At 0600 on 6th the ***Atlantic Star*** reported 55-kn southerlies near 47°N, 39°W in 20-ft swells. This was about 100 mi east of a rapidly developing Low. By 1200 gales were being encountered more than 700 mi to the west and south of the storm's 968-mb center. The ***Sealand Producer,*** 700 mi to the south, reported 50-kn west southwesterlies in 25-ft seas with a slope of about

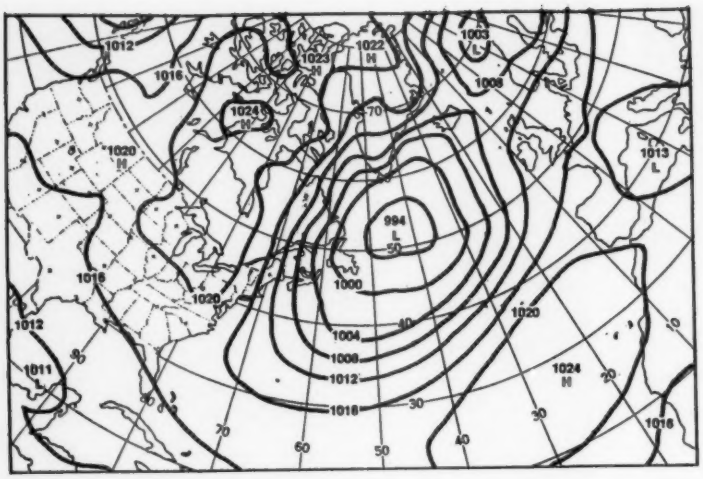


Figure 6.—The Icelandic Low reigns supreme.

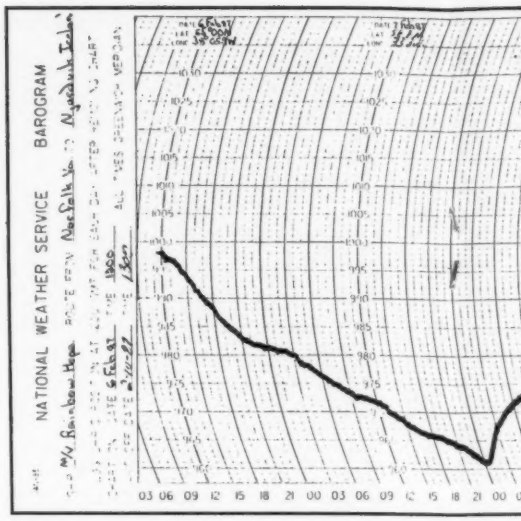


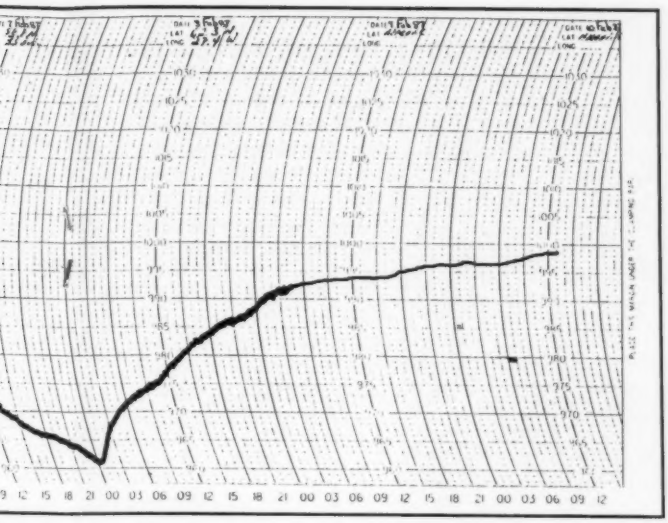
*Figure 7.—The **Rainbow Hope** measures a 962-mb pressu*

1/5. On the 7th a number of ships encountered winds in the 45- to 55-kn range, including the ***Canadian Explorer, Dart Americana,*** ***SVC Atlantic Compass and the Cryos***. Swells of up to 30 ft were being reported. The ***Rainbow Hope***, from Norfolk to Iceland recorded a 962-mb pressure on the 8th just after 0000 (fig 7). This was the lowest pressure in the life of the storm. Later on the 8th it began to fill and turn toward the east southeast. It lasted 2 days more but fizzled before reaching England.

This Low began on the 13th and developed rapidly. By 1200 the ***S. Petri***, near 33°N, 60°W, encountered 48-kn south southwesterlies in 18-ft seas while the ***Boree***, just northwest of the storm's center, was raked by 45-kn north northeasterlies in 16-ft seas. Six hr later winds onboard the S. Petri were up to 52-kn and seas increased to 25 ft, while the ***Dumont D'Urville*** had a 54-kn blow. The storm was swinging northward as it continued to intensify. By 1200 on the 14th pressure near its center dropped to 954 mb (fig 8). The ***Zim Iberia***, some 200 mi to the southwest, hit 60-kn northwesterlies and reported a 971-mb pressure. Several other ships, farther away, were reporting 50-kn winds. The ***Rainbow Hope***, which ran into the last storm, came in with 50-to 55-kn winds in 39-ft swells on the 14th and 15th. The ***Zama Maru***, at 0600, estimated 71-kn southwesterlies near 44°N, 45°W while the ***Dumont D'Urville*** (40°N, 64°W) reported 68-kn winds. Winds were generally in the 50-to 60-kn category. At 1800 the following vessels reported winds of 60-kn or more: The ***Nedlloyd Rotterdam, Concorde Caribe, Atlantic Song***, C4PA and the DDRC. Swells were frequently in the 30-ft range with seas 10 to 16 ft. On the 15th, as the storm recurved toward the northwest, it remained potent. The VPHA hit 65-kn winds at 0000, near 48°N, 45°W, while the VSBC reported in with 64-kn northwesterlies. Both were battling 33-ft seas with a slope of about 1/16. These conditions continued throughout the day. Finally on the 16th the storm showed signs of abating, near the Davis St.

Monster of the Month — This potent winter storm came to life as a wave along a front in the Gulf of Mexico on the 21st. It was a complex system with several centers as it moved northeastward into Georgia early on the 23d. Later in the day it moved off southern Virginia. It was already spreading a wet blanket of heavy snow over the mid Atlantic coastal area. Winter storm warnings were posted across Delaware, most of Maryland and sections of Virginia. The snow spread to New England as the system rapidly moved offshore. On the 23d at 1200 the 980-mb center was near 38°N, 71°W, and heading eastward. In its wake the system left nearly 2 ft of snow in some areas of Pennsylvania and 1 ft or more in other areas.

However, this system was just beginning. By the 24th, at 1200, its central pressure fell to about 954mb—a drop of 26 mb in 24 hr (fig 9). The ***Neptune Marlin*** (34.7°N, 54.4°W) in 33-ft swells encountered 63-kn westerlies while the ***Export Patriot*** (38.3°N, 52.6°W) reported 70-kn westerlies in swells estimated at 66 ft. Seas were 25 ft with an estimated slope of a steep 1/5. These timely reports were taken by Ken Baron, John Selby and Ali Rizk and sent by radio officer Sam Blunt. The storm was so violent at this point that Captain Purslow was forced to hove to for more than 24 hr. In spite of the damage suffered (see casualties) and the extreme conditions, the report was sent and used to gauge this potent storm. ***The Hood No. 3,*** about 250 mi southwest of the center, reported 65-kn north northwesterlies in 30-ft seas with an approximate slope of 1/14. Closest to the center, at 40.5°N, 53.0°W, came a report from the CG 26; winds out of the northeast at 77 kn. On the 25th, at 1200, the ***TFL Express*** (40.7°N, 39.3°W) measured a 78-kn westerly wind while battling 35-ft swells. Reported swells from the ***Sealand Leader***



a 962-mb pressure on the 8th.

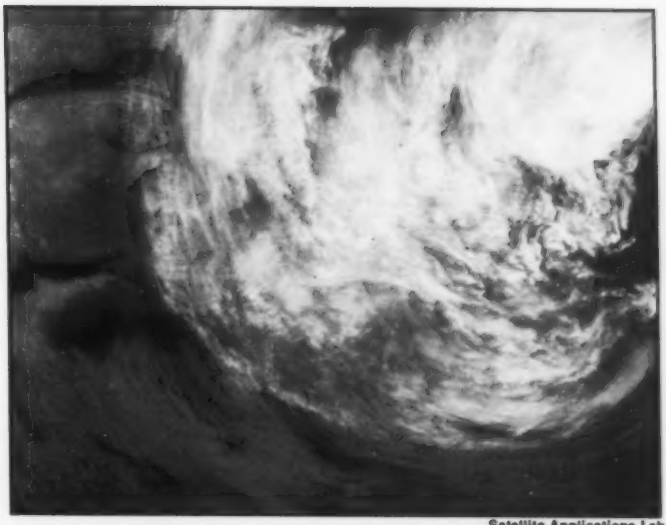


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Figure 8.—The circulation extends over Nova Scotia and the entrance to the St. Lawrence Seaway on the 14th.

ranged from 36 to 39 ft on the 24th and 25th.

This brutal storm took its toll on shipping, as recounted in the casualty section. Its central pressure fell to a low of about 952-mb on the 25th as it headed northeastward. The ***TFL Express*** and ***Sealand Leader*** continued to document its intensity with timely reports. Gales were being reported out to 1000 mi west and southwest of the center. Storm force winds continued near the center as it began to turn northward. By the 27th it was recurving toward Greenland but remained potent. At 1200 on the 26th the ***Obva,*** near 51°N, 40°N, encountered 58-kn northerlies in 30-ft seas.

Casualties — From one of the most severe storms of the winter comes an extensive report of ship mishaps. The container vessel ***Tuxpan*** (fig10) disappeared without a trace on the 24th about 1 000 mi northeast of Bermuda. There were 27 Mexican nationals onboard. Mr. Helmut Mueller, vice-president of Tecomar SA, owner of the vessel, said "we have been operating on that transatlantic route since 1977, and never have our ships encountered weather such as this." ***The Balsa 24*** capsized that same day about 300 mi southwest of the Tuxpan. Only one of the 19-member crew, which abandoned the Philippine fishing boat, was saved. The submarine ***USS Scamp*** , despite being pounded by reported 50-ft seas with bilge pumps taxed, tried to pull close to a life raft, which overturned as the men jumped. Submariners were able to haul one man onboard before the sub had to withdraw to keep from being swamped. Four others in life jackets clung together while the Israeli freighter ***Zim Miami*** tried unsuccessfully to reach them and one man on the life raft. The ***Frisia*** also tried to rescue two other men in a life boat but was unable to.

On the 24th NOAA received a weather report from the ***Export Patriot*** (see storm summary). A short time later the crew was fighting to save the vessel as a giant wave smashed the wheelhouse(fig 11). The ship was taking on water and a crewman had to be lashed to the bulkhead to keep him from washing overboard as he tried to steer the ship. She was near 38°N, 53°W on the 24th when the wave hit (fig 12). Near 33.5°N, 62.3°W, the 9,003 - ton cargo ship ***Diana*** also sustained damage when four containers were swept off her decks. Earlier in the storm's history the ***Delores Marie*** sank off the Maryland coast with the loss of all three crewmen.

On the 13th the ***Bora Isik*** ran aground and sank about 700 mi off New York. All but three of the 27 crewmen were rescued by a passing German vessel. On the 27th the ***Antonio Gramsci*** had to be pushed away from ice outside the harbor off Provoo, Finland. The Soviet tanker had run aground the night before.

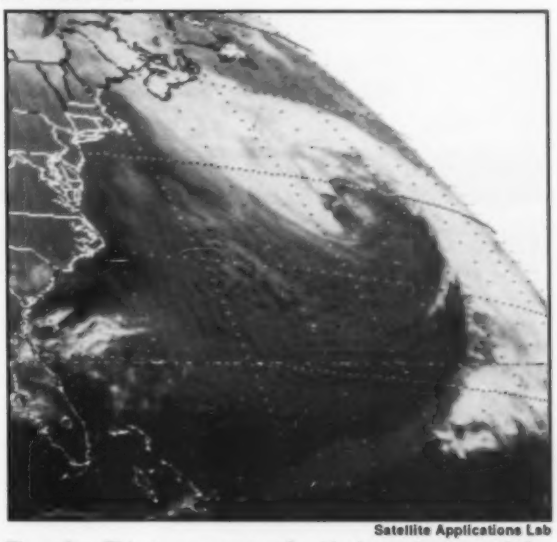

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Figure 9.—This storm was potent for shipping as it was caught by satellite at 0831 on the 24th.

Figure 10.—The ***Tuxpan*** *was one of two vessels that were presumed lost during the height of the storm. A few days later one of her containers was spotted on the surface. It was thought to be from below decks, which would indicate that the ship may have been hit by a large wave. She was last heard from on the 24th at 1200, and there was no distress signal heard before she went down. The* ***Tuxpan*** *was part of the Voluntary Observing Ship Program.*

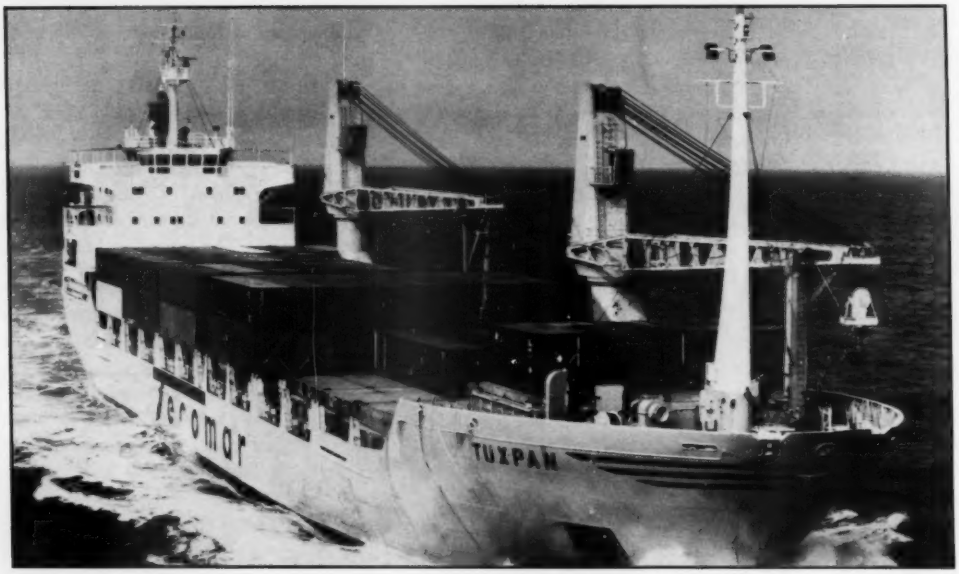
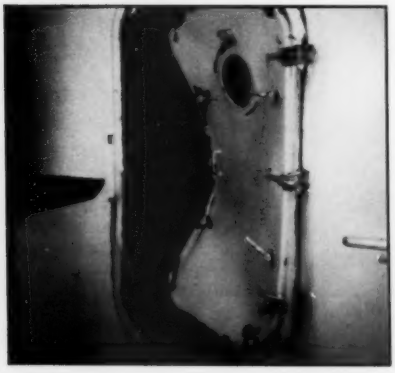


Figure 11.— The ***Export Patriot*** *is an outstanding example of the ships that voluntarily take weather observations at sea in all conditions. Despite battling for their lives the crew sent in some important reports to enable forecasters to get a handle on this explosive storm. Below is an example of the conditions they were experiencing.*



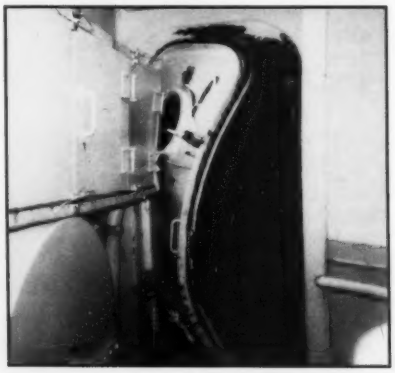


Figure 12.— The ***Export Patriot*** *was blasted by a wave that did a pretty good job on this Starboard door leading to the fo'sle head.*
In addition, the wheelhouse was flooded out five different times while three bridge windows were shattered.

March, 1987 — The end of winter was marked by an early spring over the northern shipping routes. There were plenty of storms, but most were not intense. Cyclones were active in the Greenland - Norwegian - North Seas region, resulting in a slightly stronger than normal Icelandic Low in these waters (fig 13). However from the Bay of Biscay to the Grand Banks a ridge of high pressure kept anomalies in the +4 to+6 mb range and weather conditions benefited accordingly. Steering levels (700 mb) indicated a low pressure trough off the East Coast of North America with flow becoming nearly zonal over the eastern North Atlantic.

On this date — March 5, 1962 — A tremendous storm was raging along the Atlantic Coast. It caused more than $200 million property damage from Florida to New England. Winds along the coast reached 70 mph and raised 40-ft waves. As much as 33 in of snow fell in the mountains of West Virginia.

Extratropical Cyclones — A plethora of mid Atlantic storms that moved along the upper level steering currents toward Greenland made for troublesome weather over the northern shipping routes. On the 9th and 10th gales were reported along the coast from Virginia to New England.. Gale warnings were also posted over Lakes Erie and Michigan. Across the Atlantic a similar problem was plaguing the eastern Mediterranean. In addition blizzards were burying Istanbul under snow up to 3 ft deep. On the 10th it was reported that Cyprus was suffering its worst March weather for many years as snow, rain, hail and high winds hit the island for seven consecutive days. To the north, about one week later, up to 50 vessels were trapped in ice, off the coasts of Finland and Sweden, by strong southeasterly winds. Officials said that these were the worst Baltic ice conditions for more than 30 yr as winds and currents in the Gulf of Bothnia piled ice up to 3 ft thick.

✹

This storm was first detected over the Hudson St, just south of Nottingham Is, on the 6th. Its 978-mb center moved across the tip of Labrador and into the Atlantic that same day. Its circulation extended south of the Grand Banks with a cold front that trailed back into New England. The ***Belinda*** (45°N, 51°W) encountered 60-kn west northwesterlies in 16-ft swells, with air temperatures near freezing. The ***Wilfred Templeman*** , a little farther west, in -5°C temperatures reported 55-kn winds while the ***Vaygach,*** just ahead of the front, near 48°N, 45°W, was belted by 58-kn south southwesterlies. As the storm reached the southernmost point of its journey, on the 8th, central pressure dropped to 960 mb, and its circulation dominated the northern shipping lanes. AT 1200, on the 8th, winds ranged from 45 to 60 kn. Swells were running up to 23 ft. The strongest winds were reported about 200 to 250 mi southwest of the center; the vessels involved included the ***Dart Americana, Ivan Chichkine,*** and the ***Macau.***

The system, after reaching its peak, made a rather dramatic swing towards the north northwest on the 9th. It remained potent as winds in the 60-kn range kept coming in. The STRO, near 47°N, 43°W, hit 34-ft swells at 1500 on the 8th. AT 0000 on the 9th the ***Husum*** , 300 mi south of the center, hit 60-kn westerlies. On the 10th, the weakening storm moved over Greenland.

Monster of the Month — While numerous systems roamed the North Atlantic over the next several weeks, it wasn't until the 26th that another violent storm emerged. This Low took over from a previous system near 51°N, 20°W. Its central pressure dropped from 979 mb on the 26th to 952 mb on the 27th, by which time it was moving across the British Isles (fig 14). At 0000 on the 27th the ***Matco Avon*** (50°N, 9°W) hit 53-kn south southwesterlies, while 6 hr later the ***Christina*** reported 60-kn west southwesterlies, Her seas were 43 ft with a slope of about 1/5 — very steep. The ***Christina*** also reported similar conditions at 1200, the same time the ***S.A. Waterberg*** hit 60-kn winds while battling 39-ft swells near the entrance to the English Channel. In the North Sea ships and rigs indicated winds were running 45 to 55 kn in swells of 15 to 30 ft. The ***Sunnivar*** was hit by a freak 100-ft wave north of Orkney (see casualties). The storm crossed the North Sea on the 27th and 28th, and maximum winds climbed to 60 kn throughout the 28th as the system moved across Norway and Sweden. The system remained potent through the 29th.

Tropical Cyclones — The only March tropical cyclone on record occurred in 1908. It became a hurricane on the 7th before moving through the Leeward Islands on a unusual south southwesterly course.

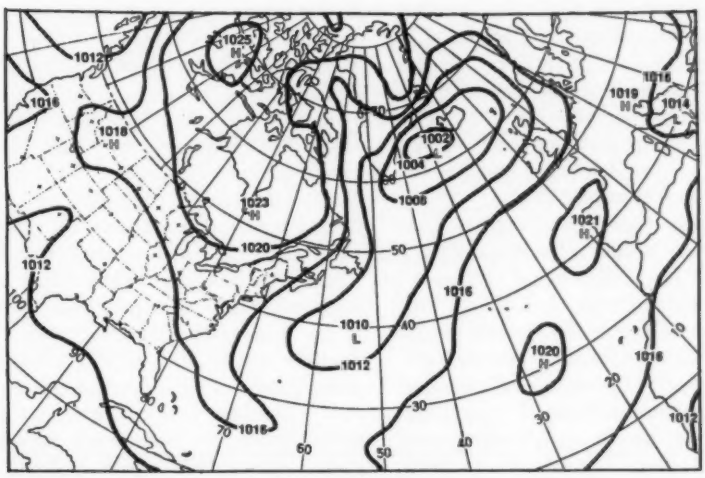


Figure 13.—This chart reflects an early spring.

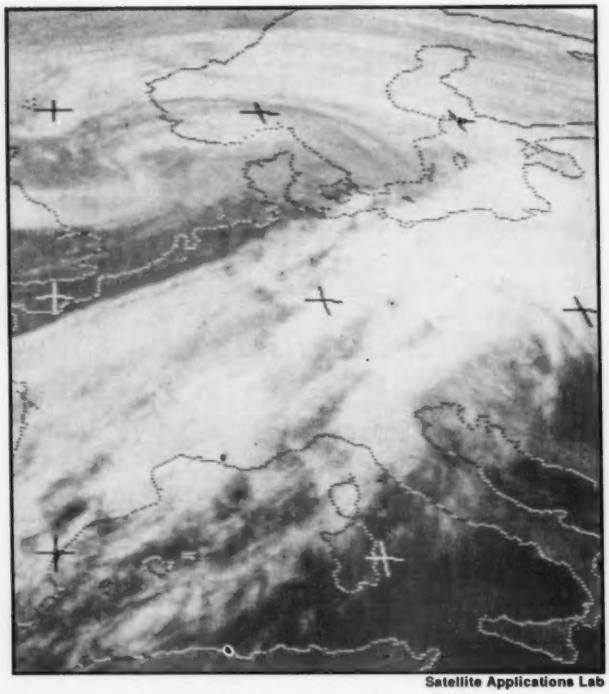


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Figure 14. — A potent 952-mb storm on the 27th at 2030.

U.S. Coast Guard

*Figure 15. — A Coast Guard rescue helicopter hovers over the 482-ft freighter **Komsomolets Kirgizii** 10 mi off the New Jersey coast on the 14th.*

Casualties — There were two marine incidents this month that grabbed worldwide attention. The ***Herald of Free Enterprise*** , which left Zeebrugge on the 6th, capsized with the loss of some 200 people. Weather was not a major factor in this tragedy although, ironically, the doors, which were left open, would have been closed during stormy weather. The other mishap involved the Soviet freighter ***Komsomolets Kirgizzii*** (described in last issue), which sank in stormy seas about 200 mi off New Jersey on the 14th (fig 14). In conjunction with the storm described in the previous section, the newly refurbished and renamed ferry ***St Sunnivar*** , on a VIP trip to inaugurate a new service between Aberdeen and Scotland's Northern Isles, was damaged by a huge wave which smashed the vessel's bridge on the 28th. The wave, estimated at 100 ft, crashed through bridge windows in the seas just north of Orkney. The ship broke off her journey and returned to Aberdeen. In another incident the tug ***Wallasey*** was on her way from the River Mersey to Oban when she was hit by a giant wave near the mouth of the Mersey, smashing the wheelhouse. The weather severely disrupted channel services in the Irish Sea. In the south, nine of twelve crewmen of a Spanish trawler died when she sank some 240 mi northwest of the Canary Is. The crew had abandoned the ***Calpe Y. Quintans*** in heavy weather. The ***Orque*** and two helicopters arrived quickly and pulled two survivors from the cold waters. The ***Thompson Lykes*** sustained heavy weather damage, on the 30th, on a voyage from Leghorn to Portsmouth, VA.

During the first week to 10 days of the month heavy weather affected a number of vessels in the Mediterranean. These included the ***Monte Roro, Giorgos N., Naci Deval and the Producer.*** On the 6th two fishermen were lost when their boat was smashed. In Istanbul it was reported that two seamen died and 22 others were missing, on the 4th, as blizzards swept western Turkey. The two seamen along with 11 others were aboard the ***Turkol*** , which crashed onto rocks on the Black Sea coast, near Kilyos. In addition the ***Mehmet Reis*** , with a 11-man crew, sent distress signals because of strong winds off Saros Bay, in the northern Aegean and nothing was heard from her after that. In other accidents the ***Irene C.*** ran aground during passage through the Bosporus to the Black Sea while the ***Demirci Mehmet*** ran aground in the region of Camburnu, Dardanelles.

Early in the month some rough weather in the North Sea played havoc with shipping and drilling operations. Crewmen had to be lifted off the ***Ulysses*** by a rig helicopter and were taken to the drilling platform ***Frigg***. The ***Fabian***, near 60°N, 1°E, was hit by a heavy sea, stoving in the bridge and causing electrical power failure. In the Gulf of Mexico, on the 6th, the ***Captain Fred*** sank in 16-ft seas and gales. Four survivors, who floated for six days in a rubber raft, were rescued by a Greek vessel, the ***Andangel Intelligence*** , about 250 mi south southeast of New Orleans.

Marine Weather Review (cont'd)

North Pacific Weather Log
January, February and March

January, 1987 — The Aleutian Low was in its glory (fig 1). It was stronger than normal by about 18 mb at its center, which was slightly northeast of its normal position. The subtropical high was also broader and stronger than normal, tightening the pressure gradients even more. One look at the monthly cyclone track will indicate what made up the Aleutian Low. These storms were guided by the 700-mb pattern, which showed a cyclonic flow across the entire Pacific. This flow was zonal between 160°E and about 160°W, from west to east.

On this date — January 6, 1880 — Seattle, WA was in the midst of their worst snowstorm ever. After the storm 4 ft of snow covered the ground. Hundreds of barns were destroyed and transportation was brought to a standstill.

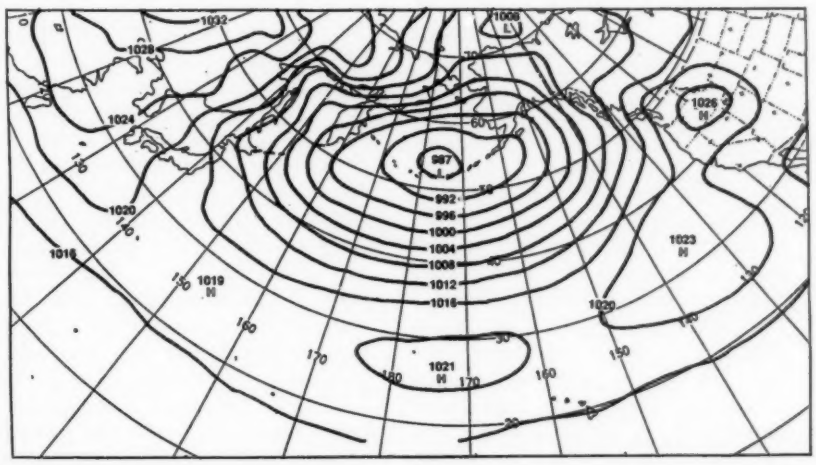

Figure 1. — The glory of the Aleutian Low.

Extratropical Cyclones — The month began with a cold front from a nearby Low moving into the West Coast bringing heavy rain and snow over much of western Oregon and the northern half of California. Along the Oregon coast, on the 2d, winds gusted to 56 mph at Seaside and 96 mph on the bluff at Cape Blanco. The month ended in a similar fashion along the West Coast. On the 27th an intense storm dumped heavy rain and snow along the Pacific Coast. Winds gusted to 62 mph at Cape Flattery, WA. In addition to the storms described below, several short-lived but intense systems played havoc with shipping during the month.

Monsters of the Month — The first storms of the new year were nearly twins and played havoc with shipping across a

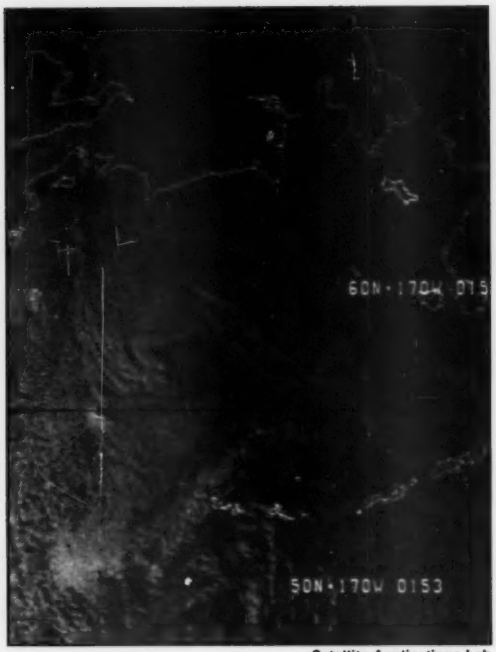

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Figure 2. — A distant view of two competing centers on the 4th.

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Figure 3. — This storm was about at its peak on the 8th.

wide expanse of the Pacific. The first system was actually conceived in the last of the old year, off Hokkaido. It developed rapidly and by the 2d near 47°N, 170°E central pressure was down to 958 mb — a full blown monster. This was testified to by the ***Kasina, Ever Valor, Lucent Star, Brooklyn*** , and ***President Washington.*** Winds from these vessels were in the 45- to 55 - kn range, in swells that ran from 30 to 38 ft. ***The M'Dermott Lay Barge, No 25, Lucid Star*** and ***President Wilson*** encountered winds around 60 kn south and southwest of the center. On the 4th, a second center developed and quickly became dominant. By 1200 its central pressure was down to 956 mb (fig 2). Wind and pressure reports sent in by the ***Ace Accord, Sealand Defender, Lars Maersk, Kent, Great Land*** and ***Skoubord,*** among others, were helpful in determining the intensity and splitting of this system. The first center ended up in the Bering Sea on the 4th while the second one made it to the Alaska Peninsula by the 7th.

This system formed east of Shanghai on the 4th. After moving across the Ryukyu Is, it took an east northward course across the Pacific. It developed slowly and it wasn't until the 6th at 0500 that ***Sealand Explorer,*** which passed close to the center, gave the first clue that the storm was getting it together. She encountered 45-kn winds in 25-ft seas with a slope of 1/13. By the 7th, pressure had fallen to 968 mb. The ***World Wing II***, some 550 mi to the southwest of the center, hit 46-kn westerlies in 16-ft swells. At 0000 on the 8th, close to the center, the ELMDG encountered 50-kn winds, while being buffeted by 33-ft swells. The central pressure reached a minimum of about 958 mb at 1200 (fig 3). The ***Cecilie Maersk*** hit 50-kn winds, at 0600, in 25-ft seas with a steep slope of about 1/7. The following day the storm turned toward the northeast. Southwest of the center the ***President Monroe*** ran into 58-kn northerlies in 25-ft seas, at 1800 on the 9th. However, the storm was beginning to fill. It finally reached the coast of British Columbia, just north of Vancouver Is, on the 12th.

This system sprang to life off Kyushu, on the 12th. Running northeastward it developed rapidly. By the 13th its central pressure was down to 959 mb — a drop of 37 mb in 24 hr. The potency of this system was discovered by the ***Oriental Minister,*** which hit 48-kn west southwesterlies in 31-ft seas at 0600 on the 14th. The ***Sunbelt Dixie*** was nailed by 50-kn southerlies near 32°N, 159°E at 1200 on the 13th. The ***Priliv*** , near the center, measured a 969-mb pressure in addition to 47-kn winds. The storm continued to intensify and, by the 14th at 1200, pressure had fallen to 950 mb. Storm force winds were common across the northern shipping lanes. East northeast of the center, at 1900, the ***President Taylor*** battled 55-kn easterlies in 35-ft swells. To the southwest, at 0600 on the 15th, the ***Giovanni*** encountered 58-kn northwesterlies. By this time the storm was well into the Bering Sea where it spent the remainder of its life, remaining dangerous through the 17th.

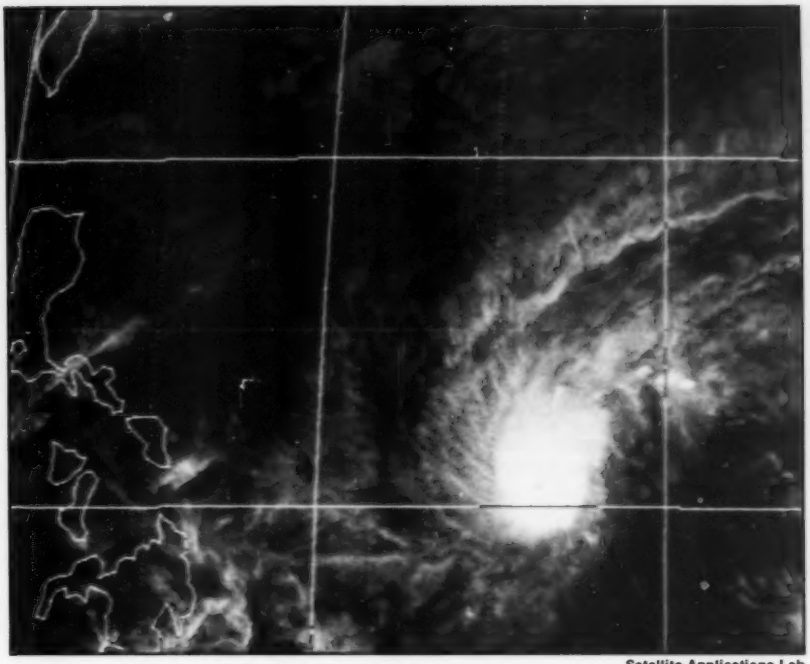

Figure 4. — Typhoon Orchid at 0900 on the 11th.

On the 22d along the China coast, north of Shanghai, a small Low developed. This system moved across the East China Sea and Sea of Japan during the next 2 days. By the 24th it was skirting the Kuril Islands and beginning to get organized. From a 990-mb pressure at 1200, on the 24th, it developed into a 969-mb center 24 hr later. Over the 26th and 27th the ***President Jefferson*** battled this storm continuously. At 0000 on the 26th she ran into 55-kn winds, with a 963-mb pressure, in 30-ft swells near 51°N, 162°E. Six hr later winds were measured at 80 kn in 35-ft seas. Throughout the rest of the 26th and into the 27th her winds remained between 60 and 65 kn and, on the 27th, at 0000 the swells were up to 41ft. Later on the 27th the Sealand Defender rang up 48-kn winds in 30-ft swells. By this time the system, whose pressure fell to 952 mb on the 26th, had turned westward over the Kamchatka Peninsula where it was laid to rest on the 28th.

Tropical Cyclones — On the 8th typhoon Orchid came to life near 70°N, 150°E, among the Caroline Is. It reached typhoon strength on the 10th as it headed toward the west northwest. The following day maximum winds reached 100 kn (fig 4). By early on the 12th the system turned westward, but winds fell back to 70 kn. Before the day was through Orchid dropped to tropical storm strength as it approached the Philippines. Fortunately the system weakened rapidly and fell apart before reaching the islands, on the 14th.

Casualties — Around mid month a Japanese fishing boat rescued 59 people from the ***Vishva Anurag*** , when she capsized in rough seas off the Japanese coast. The ***Ming Autumn*** had 22 containers damaged on the 4th and 5th on a voyage from the Far East to Long Beach. The ***Hana*** , from Honolulu to Kahului, experienced heavy weather damage and spilled about 1000 gallons of bunker sea oil in the Molokai Channel, east of Honolulu on the 18th. The ***Stuyvesant*** spilled an estimated 1 million gallons of North Slope crude in the Gulf of Alaska as she bucked through heavy seas and gales, south of Valdez, on the 6th and for several days.

February, 1987 — As usual the Aleutian Low was the dominant climatic feature (fig 5). It was 7-mb deeper than normal from the Bering Sea southward to 35°N. Elsewhere conditions were near normal and the steering patterns at 700 mb showed a general zonal flow from Japan to 170°W where there was a turning northeastward.

On this date — February 10, 1978 — As much as 8 in of rain fell over Southern California, resulting in widespread flooding and mudslides. The heavy rain produced a wall of water, which ripped through the mountain resort community of Hidden Springs, drowning 13 people. The storm caused $50 million damage.

Extratropical Cyclones — The intensity of the Aleutian Low reflected the number and intensity of Lows that moved over the shipping lanes throughout the month. The tracks also show the 700-mb pattern; particularly apparent are the storms moving into the Gulf of Alaska. The month began with gales being generated off the south coast of Oregon and northern California. Wind gusts of 100 mph were reported at Cape Blanco and 85-mph winds were clocked at Newport OR, early on the 1st. Around the middle of the month Bejing, China suffered through 3 days of sleet and freezing rain, which brought transportation to a virtual standstill. To the south Eastern Jawa suffered the worst floods in 74 yr, triggered by a week of rains.On the 24th a Low over Nevada triggered gale force winds off the California coast as it combined with a 1038-mb high centered near 47°N, 143°W.

On the 3d a Low developed south of the Gulf of Alaska. It actually began a few days before as a wave along a front, which emanated from a large system over the Aleutians. Early on the 4th the ***Exxon New Orleans*** (52°N, 137°W) ran into 52-kn southeasterlies in 30-ft swells. These figures were confirmed by the ***B.T. Alaska*** 6 hr later. The ***Oji Gloria*** , just south of the center, reported a 966-mb pressure in 65-kn southwesterlies, at 0600 on the 4th. Central pressure was estimated at 956 mb (fig 6). Reports of 40-to 50-kn winds were common. However, the storm began to recurve and ran afoul of the Alaska Peninsula on the 5th.

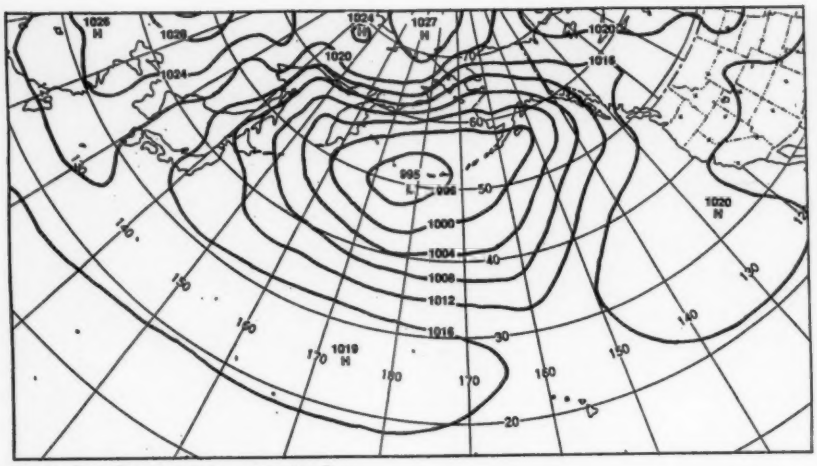

Figure 5. — The dominating Aleutian Low.

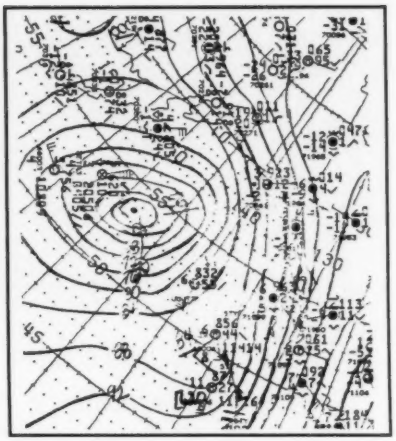

Figure 6. — The synoptic situation at 0600 on the 4th.

There was, in the wings a Low that had formed over the Gulf of Shelekhov on the 3d. After moving across the Kamchatka Peninsula it literally exploded on the 5th. Central pressure fell from 984 mb at 1200 on the 4th to 958 mb 24hr later — a drop of 26 mb. By early on the 6th it reached its minimum of about 952 mb over the Aleutians. ***The Washington Rainbow II*** , about 300 mi to the northwest, ran into 45-kn winds and a 968-mb pressure; seas were 18 ft. The ***Kapitan Tsiroul*** hit 47-kn northeasterlies in 16-ft seas at 0600. On the 6th the still potent storm began to dissipate almost as quickly as it developed. It stalled and eventually was absorbed by another system to the south.

Another short-lived system popped up around mid month off Hokkaido. Actually it was more complex than that. On the 13th a system developed very rapidly over the Kamchatka Peninsula. It had a 966-mb center at 1200 and its circulation extended south to Japan. Winds in the 45-to 55-kn category were being reported by the ***President Washington, Refina Maersk*** and ***Neptune Pearl.*** Swells were running up to 33 ft. The system weakened slowly as it moved, or retrogressed, toward the west. On the 14th the ***President Washington*** was in 44-ft swells near 51°N, 164°E. Within this large circulation the Hokkaido Low developed on the 14th and quickly became the dominant center. It was one of four centers competing at 0000 on the 14th. The storm moved east northeastward and generated gale and storm force winds with assistance from the previous Low. At 0600 on the 15th the STOR, about 180 mi south of the center, was buffeted by 60-kn westerlies in 26-ft seas. The ***Laura Maersk***, late on the 15th and 16th, encountered 45-kn winds, through the period, in 30-ft swells. The storm moved along the Aleutians and turned northward into Bristol Bay on the 19th. On the 17th the ***Van Trader*** near 50°N, 154°W, measured 65-kn winds in 33-ft seas. The following day the ***President Eisenhower*** (53°N, 150°W) was hit by 55-kn westerlies while battling 31-ft swells. The system finally made its way into Alaska on the 19th.

This short-lived storm came to life over the Sea of Japan on the 24th. It moved northward over the islands as a weak disturbance. However on the 26th, near Sakhalin, it deepened to 968 mb. This was reflected in the weather reports received from ships to the south of the center. At 1200 the ***Skaubord*** (41°N, 146°E) hit 50-kn west southwesterlies. Most ships reported winds in the 40-to 45- kn range. Swells were running up to 16 ft. By the 27th the storm began to fill as it drifted through the Sea of Okhotsk.

Tropical Cyclones — No tropical cyclones occurred this year. The last February typhoon was last year when Judy came to life. Prior to that, there had not been one since 1970.

Casualties — A cypriot flag bulk carrier is believed to have sunk about 450 mi south of Manila in the Sulu Sea. The ***Tina*** carried a crew of 21 and was enroute from Los Angeles to Bombay. In thick fog, the ***Quatsino Sound*** sank outside the Taiwanese port of Keelung after a collision with the containership ***Ever Linking*** . Her 21-man crew was rescued.

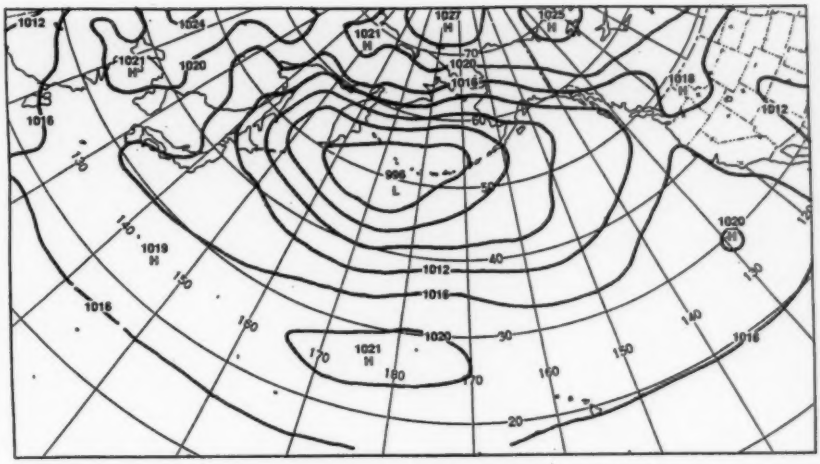

Figure 7.— The Aleutian Low continued to be the dominating climatological factor.

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Figure 8. — One of the Aleutian Lows on the 12th.

March,1987 — A broad, extensive Aleutian Low covered the entire North Pacific, north of about 35 °N (fig 7). This resulted in a widespread -9 mb anomaly and kept the subtropical high at bay, south of 30°N. The steering pattern at 700 mb was similar to the previous month, with a zonal flow east to 170°W and a trend toward the Gulf of Alaska.

On this date — March 12,1967 — A tremendous 4-day storm was raging over California. The storm produced 96 in of snow in 60 hr at Squaw Valley. Winds of 90 mph closed mountain passes and heavy rains flooded the lowlands.

Extratropical Cyclones — A Low off the Pacific Coast trailed a cold front across the northwestern U.S. shortly after the month opened. Gales were forecast along the northern and central Pacific Coast. Wind gusts to 60 mph rattled Astoria, OR on the 3d. More than 5.5 in of rain drenched the Waterworks area near Aberdeen WA. Medford, OR clocked 43-mph winds on the 4th. Less than one week later gales blew again along the Pacific Coast.

A common storm track in March began near Japan extended east northeastward to about the Dateline and then recurved, either into the Bering Sea or the Gulf of Alaska.

✹

The month's opener came to life near 38°N, 159°W. It intensified rapidly and by the 3d its central pressure dropped to 962mb. The ***Skeena*** ran into 40-kn southerlies in 26-ft swells near 36°N, 126°W, at 1800 on the 3d. The following day as the storm moved closer to the major shipping lanes winds of 35 to 40 kn were common along with 15-ft seas. The ***CG 29*** hit 40-kn southeasterlies at 1200 as did the ***Century Leader No. 3*** six hr later. On the 5th even though the storm was weakening as it approached Vancouver Is a number of vessels reported gales.

✹

Another British Columbia - bound storm appeared in mid ocean on the 8th. It headed east northeastward and intensified. By 0000 on the 10th central pressure had dropped to 952 mb near 45°N, 167°W. At 1800 on the 9th the ***Seikyo Maru No. 8*** reported in with 40-kn west northwesterlies in 15-ft swells. Six hr later the ***Beauteous*** hit 35-kn winds while the ***Pacific Chungsam*** some 600 mi southwest of the center hit 48-kn westerlies. The ***Century Highway No. 2*** , about 200 mi southeast of the center, was clipped by 40-kn south southeasterlies in 13-ft swells. Gale force winds continued as the storm headed northward on the 11th and 12th. On the 13th it began to dissipate as it turned toward the mainland.

Monster of the month. In the wake of the previous storm this system swung into action on about the 10th. It was first detected just off Kyushu on the 9th. By 1200 on the 10th the 976-mb center was racing to cross the 170°E meridian near 39°N. It attracted plenty of attention. The ***Shojin Maru*** (35°N, 157°E) rang in with 49-kn south southeast winds while bucking 23-ft swells, at 0000. By 1200 the ***Nevier*** , north of the storm, was clobbered by 58-kn nothwesterlies in 13-ft swells. The system was approaching the Aleutians, on the 11th, with a 964-mb center. The JBEJ, about 140

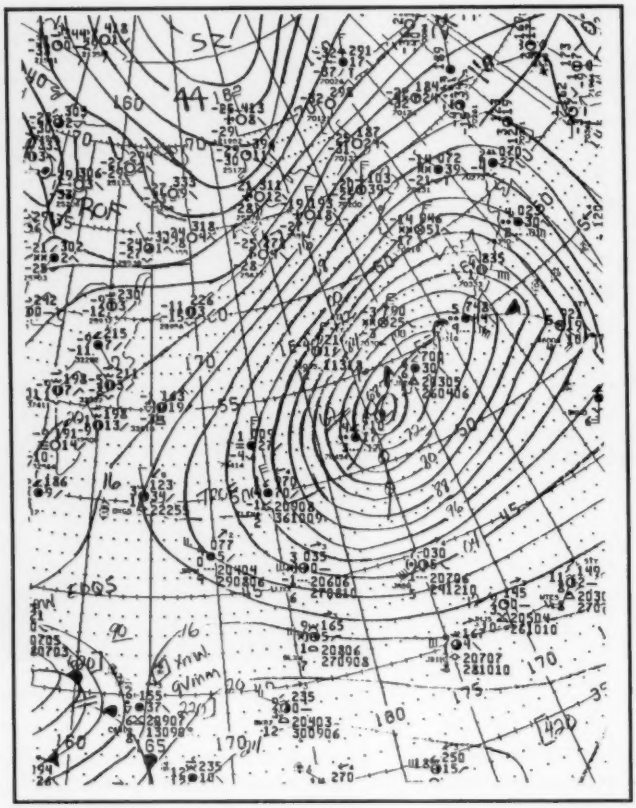


Figure 9.— The synoptic situation at 0000 on the 21st. The Kamchatka Peninsula lies in the northeasterly flow to the rear of the 962-mb storm.

Figure 10.—Satellite view of the water off the Kamchatka Peninsula shows an area of wavy lines aligned with the wind flow.

mi to the south, at 0000, ran into 48-kn westerlies in 23-ft seas with a slope of about 1/30; she measured a pressure of 969 mb. Six hr later the ***Fort Frontenac*** (44°N, 176°E) battled 60-kn westerlies in 33-ft swells and reported a 958-mb pressure. Gales were extending out about 600 mi to the south and southwest of the storm (fig 8). Swells were highest in the southeast quadrant out to about 600 mi, where they ranged from 25 to 30 ft. Northeast of the center, by about 300 mi, the ***Hawk Arrow*** reported 40-kn winds and swell was only running 13 ft. At this time (0000 on the 12th) the storm was about at its peak. Central pressure was near 952 mb. At 0600 the ***Nosac Takayama,*** about 100 mi south of the center, reported 48-kn southwesterlies and a 983-mb pressure. On the 13th and 14th the storm moved over the Aleutians and turned a counterclockwise loop. A new center developed on the 14th and the storm once again intensified. Central pressure fell to about 958 mb by 0000 on the 15th. The storm had made its way into the Bering Sea and, at about 1200, turned eastward. It moved through Bristol Bay, across the Alaska Peninsula and into the Gulf of Alaska by the 16th. The following day it began to dissipate.

This system popped up east of Tokyo on the 15th. It moved rapidly east northeastward and intensified. However it wasn't until the 17th that the system developed into a potent storm. The 968-mb center was near 50°N, 175°E. South of the center, at 0600, the ***Neptune Diamond*** was raked by 48-kn winds out of the west southwest. At 0000 on the 18th the ***Golden Apo*** (52°N, 166°E) reported 50-kn northerlies and a 976-mb pressure; seas were running 20 ft. The storm's central pressure was estimated at 961 mb at this time. Gales and 20-ft swells were being observed up to 700 mi to the south. Conditions continued to be rough throughout the day. However, on the 19th , the system weakened rapidly and gave way to another storm in its wake.

This Low, in the wake of the previous storm, had developed on the 17th over Kyushu. Its path was similar until it crossed 175°E on the 19th. It then headed northeastward toward the Alaska Peninsula. About this time the storm began to organize into a potent system. On the 20th its 968-mb center crossed 50°N near the 175°W meridian. Near the center the ***Ned Poinsetta*** reported 45-kn easterlies in 25-ft

Figure 11.—This is the wavy line area in fig 10 with a 1 km resolution. It shows the dramatic effect of the cold air influx behind the Low in the form of stratocumulus.

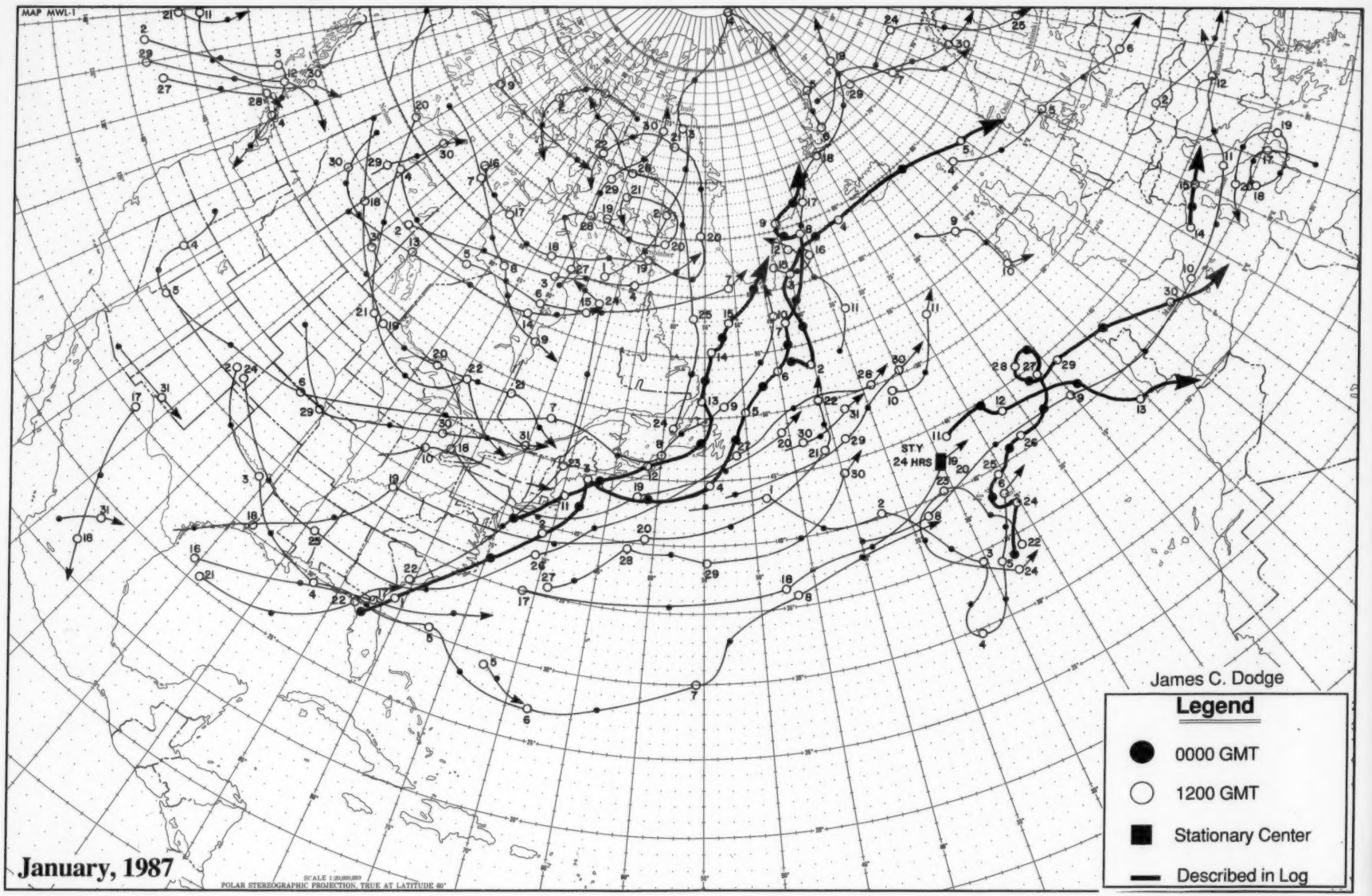
seas with a slope of about 1/20. On the 21st, as the storm moved along the Aleutians (figs 9-11), the 3 ETQ, near 54°N, 176°W, ran into 49-kn north northeasterlies in 15-ft swells; she recorded a 980-mb pressure. The following day the storm, after moving through Bristol Bay, recurved into the Bering Sea.

Another Japanese born storm came to life near Kyushu on the 23d. This one moved right along the islands, across the Kurils and into the Sea of Okhotsk. This is where the action took place. By 0000 on the 25th the central pressure fell to 968 mb and gales extended out to 600 mi in the southeast quadrant. East and northeast of the center, the ***Elbe Maru, Baikovsk*** and the ***Diokl*** hit winds in the 45-kn range. At 0600 the ***Antiia,*** just southeast of the center, was clobbered by 58-kn southwest winds, as was the ***Zalessovo*** 16 hr later; she also reported a 978-mb pressure. Central pressure was estimated at about 968 mb. The storm continued to deepen as it moved northward to the Kamchatka Peninsula. On the 26th at 0000 it was estimated at 964 mb. At this time the ***Kapitan Serguievsky***, near the center, reported a 965-mb pressure with 54-kn winds in 26-ft seas. This report was valuable in determining the intensity of this storm. Some 600 mi to the east, ahead of the cold front, the ***Skeena*** encountered 48-kn south southeast winds in 20-ft seas. The ***Marlin,*** at 0600, encountered 48-kn southerlies just east of the center; she measured a 968-mb pressure while battling 26-ft swells. The storm was now heading northward over the Kamchatka Peninsula. However, winds in the 45- to 50-kn range continued through the day. The storm faded on the 27th.

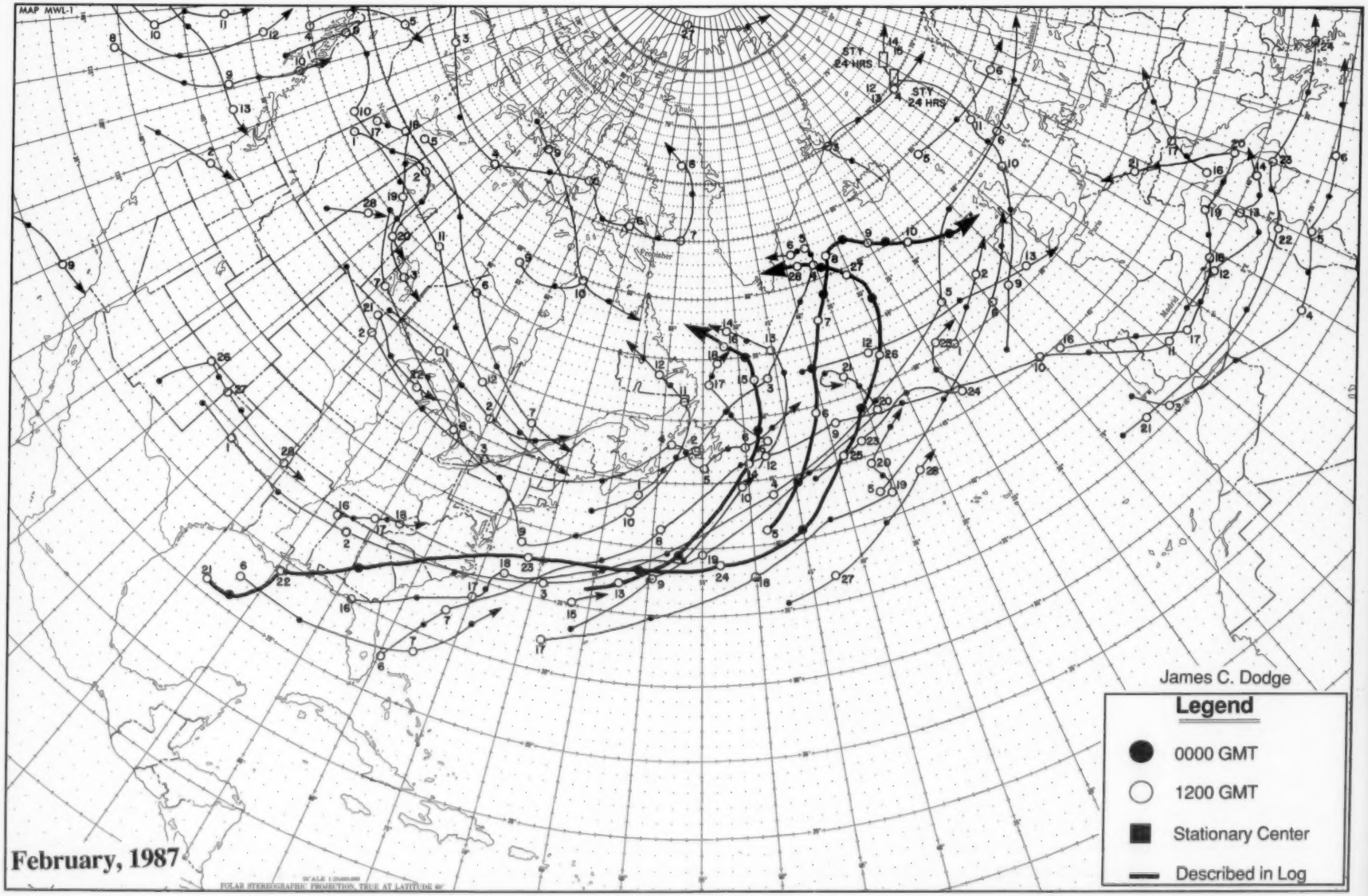
Tropical Cyclones — There were no tropical cyclones in either basin. The last western Pacific tropical storm to occur in March was in 1982. No eastern or central Pacific storm occurred in March for the period of record.

Casualties — The ***Oriental Majesty***, on a voyage from Yokohama to the U.S. East Coast, encountered heavy weather on the 1st. It was reported that 25 containers were damaged and 10 were lost overboard. At Vishakhapatnam, on the Bay of Bengal, on the 12th, heavy wind and rain caused three shore cranes to fall into the sea. The rain also soaked bags of sugar on the ***Dona, Cape Kennedy*** and ***Cape Monterey***.

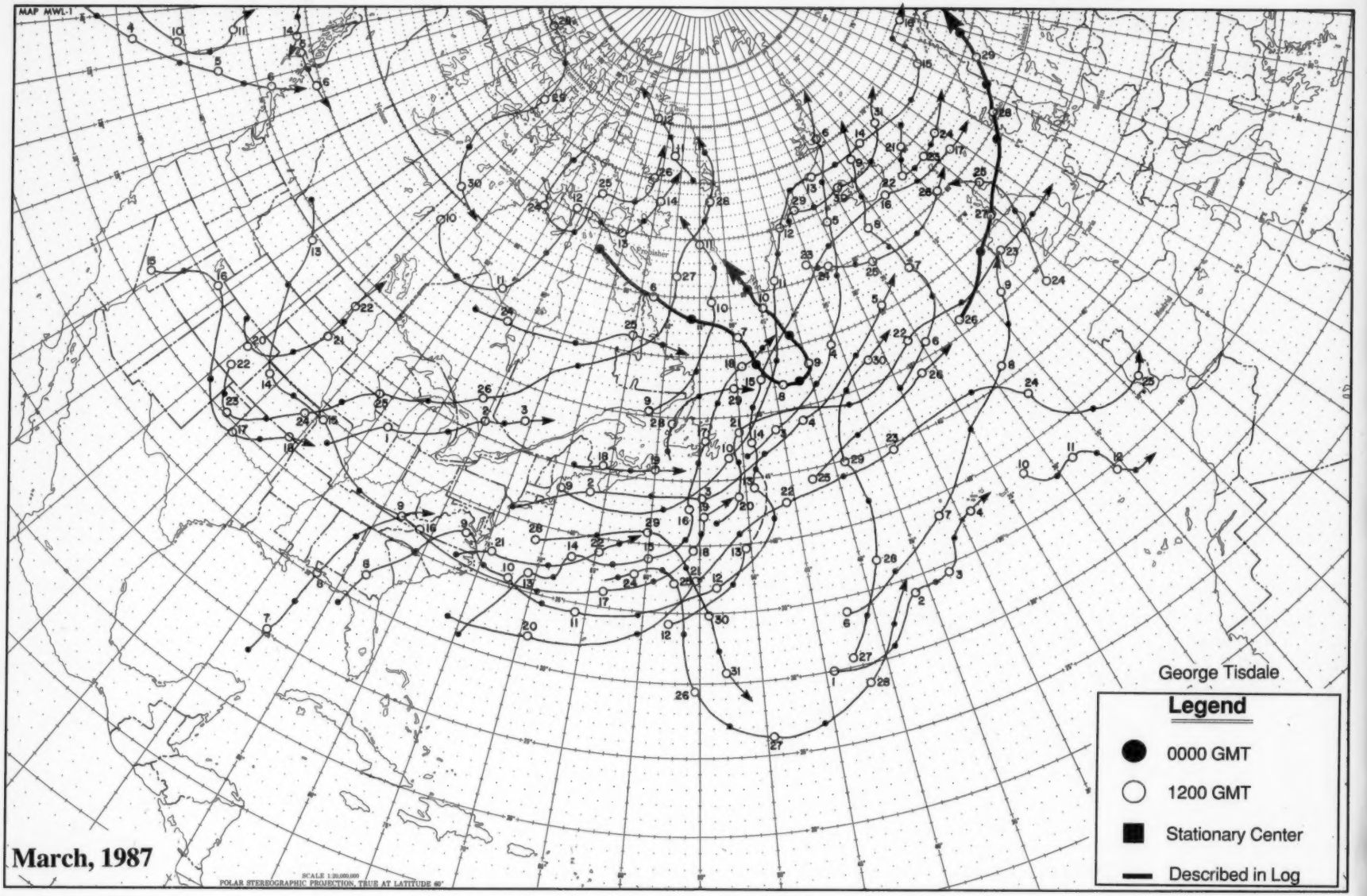
Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic



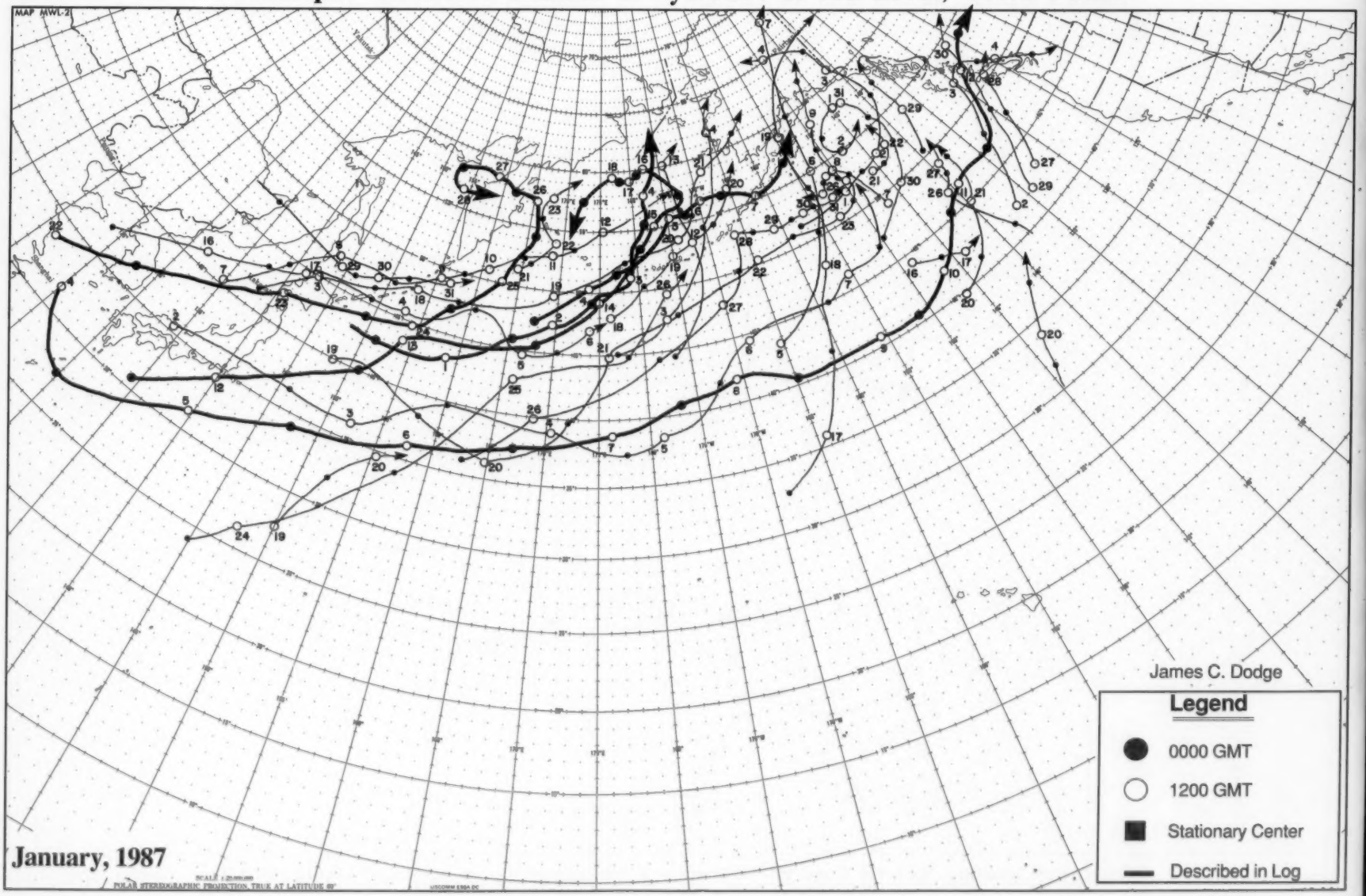
Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic



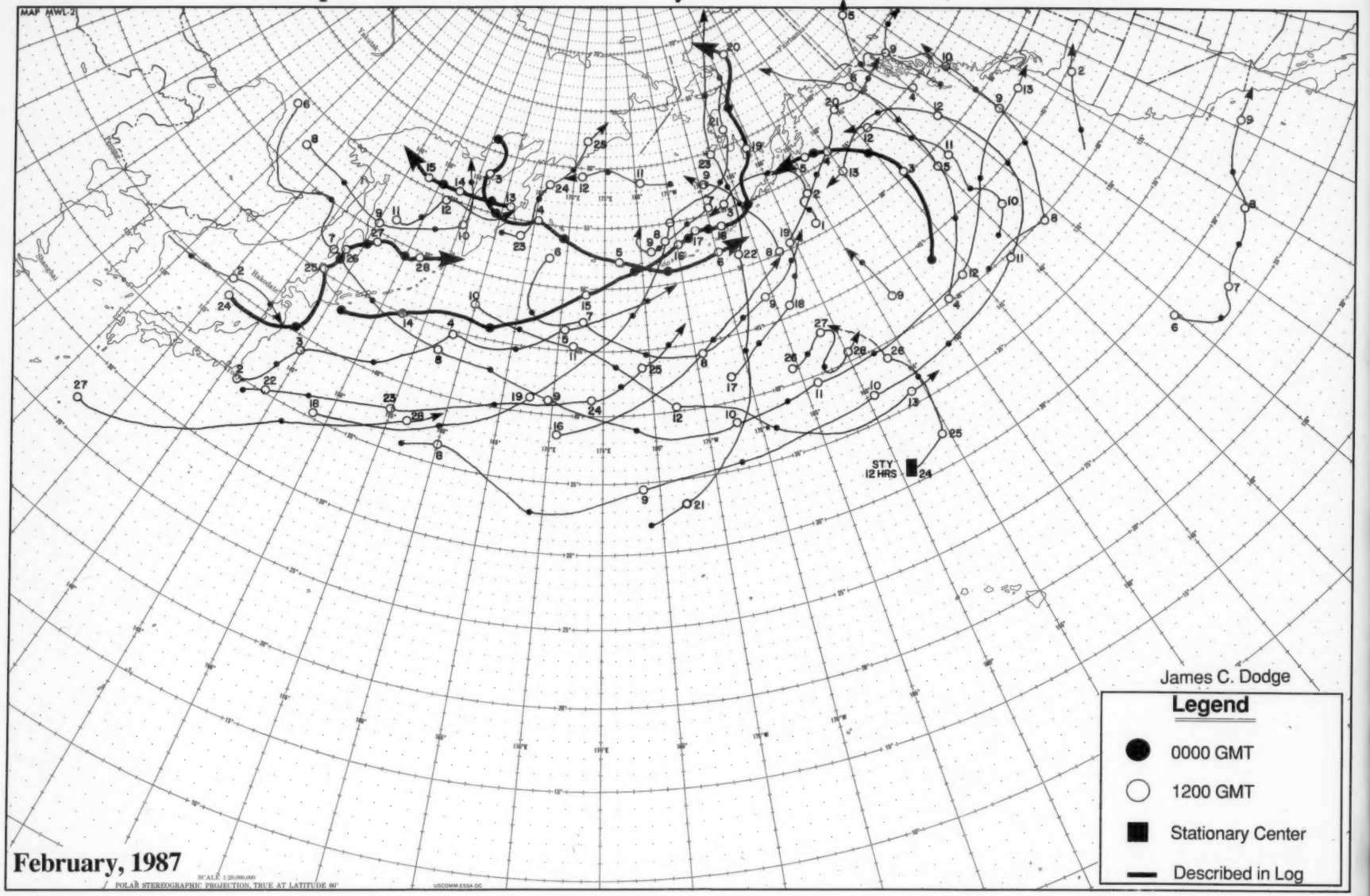
Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic



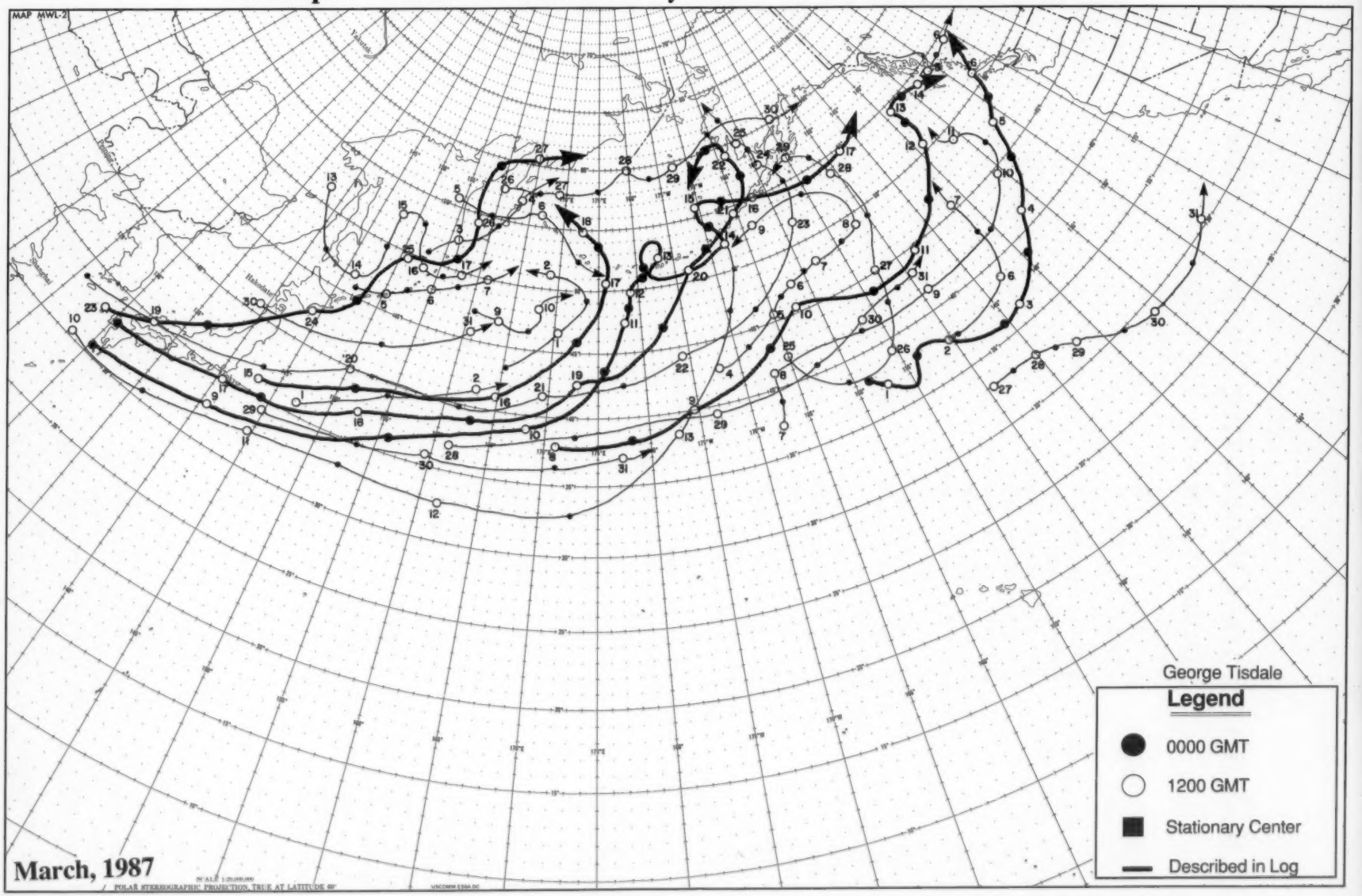
Principal Tracks of Centers of Cyclones at Sea Level, North Pacific



Principal Tracks of Centers of Cyclones at Sea Level, North Pacific



Principal Tracks of Centers of Cyclones at Sea Level, North Pacific



U.S. Voluntary Observing Ship Weather Reports

January, February and March 1987

SHIP NAME	VIA RADIO	VIA MAIL
1ST LT ALEX BONNYMAN	8	
2ND LT. JOHN P. BOBO	6	
ACE ACCORD	99	154
ACT 10	48	52
ACT 6	20	
ACT 7	121	
ACT 9	82	
ACT I	85	
ACT II	59	64
ADABELLE LYKES	25	146
ADDIRIYAH	19	78
ADMIRALTY BAY	15	176
ADONIS	9	36
AIDA	6	3
AL AHMADIAH	14	
ALASKA MARU	79	
ALASKA RAINBOW	50	121
ALDEN W.CLAUSEN	1	
ALEMANIA EXPRESS	64	
ALLEMAGNA EXPRESS	80	150
ALLIGATOR FORTUNE	54	
ALLIGATOR GLORY	39	174
ALLIGATOR HOPE	66	118
ALMUDENA	17	76
ALTAIR	1	
ALTAMONTE	26	98
ALTIMIRA		56
ALVA MAERSK	16	30
AMBASSADOR	1	
AMBASSADOR BRIDGE	118	144
AMELIA TOPIC	5	126
AMERICA EXPRESS	47	
AMERICAN LYNX	22	20
AMERICAN MARINER		14
AMERICAN MARKETER	53	210
AMERICAN MERCHANT	43	243
AMERICAN MICHIGAN	7	
AMERICAN NORTH CAROLIN	3	24
AMERICAN PIONEER	30	203
AMERICAN PURITAN	29	181
AMERICAN REPUBLIC		10
AMERICAN RESOLUTE	47	150
AMERICAN TITAN AK 1008	1	
AMERICAN TROJAN	20	44
AMERICAN VEGA	18	78
AMERICAN VETERAN	30	98
AMERICANA	29	76
AMOCO BALTIMORE	34	40
AMERICA SUN	33	131
AMERICAN APOLLO	18	21
AMERICAN AQUARIUS	9	28
AMERICAN ARGO	55	99
AMERICAN ASTRONAUT	7	36
AMERICAN CONDOR	38	4
AMERICAN CORMORANT	19	29
AMERICAN EAGLE	55	100
AMERICAN ENTENTE	39	173
AMERICAN ENVOY	9	196
AMERICAN FALCON	33	116
AMERICAN HARRISON	25	21
AMERICAN HAWAII	12	35
AMERICAN LANCER	42	33
AMERICAN LEGION		28
ANDERS MAERSK	25	19
ANDERSON		44
ANITA	11	8
ANJA LEONHARDT	2	
ANONA	8	40
ANTHONY RAINBOW	44	
AQUA CITY	105	136
AQUA GARDEN	50	58
AQUARIUS	72	194
ARCHON	14	17
ARCO ALASKA	44	55
ARCO ANCHORAGE	35	34
ARCO CALIFORNIA	33	49
ARCO INDEPENDENCE		12
ARCO JUNEAU	14	12
ARCO PRUDHOE BAY	15	16
ARCO SAG RIVER	21	20
ARCO SPIRIT	37	48
ARCO TEXAS	24	51
ARCTIC TOKYO	1	171
ARGONAUT	23	95
ARILD MAERSK	9	45
ASHLEY LYKES	8	30
ASIA WINDS	151	
ASIAN EXPRESS	44	111
ASIAN HIGHWAY	51	
ASIAN VENTURE	33	21
ASYA	50	73
ATIGUN PASS	111	262
ATLANTIC COMPANION	42	
ATLANTIC RAINBOW	23	43
ATLANTIC SAGA	59	
ATLANTIC SERVICE	40	
ATLANTIC SONG	32	
ATLANTIC SPIRIT	98	195
ATLANTIC STAR	92	
AUSTANGER	6	25
AUSTRAL RAINBOW	11	70
B.T. ALASKA	51	216
B.T. SAN DIEGO	65	211
BACOL SANTOS	86	
BALTIMORE TRADER	42	
BAR' ZAN	9	219
BARBER PERSEUS	75	
BARBER TAMPA	2	35
BARBER TEXAS	24	45
BARBER TOBA	23	
BARRYDALE	87	
BAY BRIDGE	82	38
BCR KING	94	
BCR QUEEN	53	
BEAUTEOUS	12	
BENNINGTON	6	19
BENSON FORD		11
BERNINA	55	64
BHARATENDU	8	
BHAVABHUTI	56	35
BIBI	31	
BISLIG BAY	76	
BOEFJORD	8	
BORINQUEN	56	160
BRINTON LYKES	27	16
BROOKLYN	39	172
BROOKLYN BRIDGE	5	12
BROOKS RANGE	46	64
BULK GARLAND	10	35
BUNGA KENANGA	14	
BUNGA KESIDANG	46	32
BUNGA MELAWIS	65	90
CALANUS		40
CALIFORNIA RAINBOW	83	115
CALIFORNIA VENUS	38	
CANAL ACE		46
CAP ANAMUR	1	
CAPE BORDA	19	79
CAPRICORN	1	
CARIBE 1	62	97
CARLA A. HILLS	1	163
CARMEN	37	
CAVARA	68	68
CECILIE MAERSK	24	42

SHIP NAME	VIA RADIO	VIA MAIL
CELEBRATION	16	23
CENPAC 2	43	71
CGM LORRAINE	34	
CHARLOTTE LYKES	65	139
CHASTINE MAERSK	21	81
CHELSEA	6	13
CHEMICAL PIONEER	16	70
CHERRY VALLEY	17	
CHESAPEAKE	33	24
CHESAPEAKE TRADER	42	226
CHESNUT HILL	5	147
CHEVRON ANTWERP	20	107
CHEVRON BURNABY	54	119
CHEVRON CALIFORNIA	118	204
CHEVRON COLORADO	16	54
CHEVRON COPENHAGEN	13	33
CHEVRON EDIMBURGH	35	70
CHEVRON EQUATOR	18	232
CHEVRON FELUY	14	
CHEVRON FRANKFURT	47	
CHEVRON LONDON		189
CHEVRON METEOR	59	179
CHEVRON MISSISSIPPI	107	186
CHEVRON NAGASAKI		165
CHEVRON OREGON	68	157
CHEVRON PACIFIC	10	93
CHEVRON SUN	6	130
CHEVRON WASHINGTON	29	71
CHIKUMAGAWA MARU	39	
CHRISTIAN MAERSK	34	74
CHRISTINA	47	
CHUEN ON	26	
CITADEL HILL	45	
CITY OF MIDLAND	5	75
CLARA MAERSK	15	49
CLIFFORD MAERSK	38	62
CO-OP EXPRESS I	54	
CO-OP EXPRESS II	94	35
CO-OP EXPRESS V	45	
COAST RANGE	4	
COLIMA	3	69
COLORADO HIGHWAY	28	
COLUMBUS AMERICA	186	
COLUMBUS AUSTRALIA	52	
COLUMBUS CALIFORNIA	97	
COLUMBUS LOUISANA	103	
COLUMBUS NEW ZEALAND	60	
COLUMBUS VICTORIA	143	
COLUMBUS VIRGINIA	116	
COLUMBUS WELLINGTON	126	
CONTINENTAL HIGHWAY	57	
CONTINENTAL LOTUS	2	
CONTINENTAL TRADER	3	
COPIAPO	12	
CORNELIA MAERSK	40	84
CORNUCOPIA	81	198
CORONADO	29	
COUNTESS-SKY	74	53
CPL. LOUIS J. HAUGE JR	19	27
CRYSTAL STAR	26	66
CURRENT	47	
D.L. BOWER		139
DACEBANK	85	
DALAMAN	2	
DAMIAO DE GOIS	62	
DANDY #1		110
DAVID PACKARD	11	
DAWN	41	41
DELAWARE TRADER	34	60
DIANA	2	26
DOCK EXPRESS TEXAS	98	
DOMINA	44	
DRAGOR MAERSK	8	43
DUBHE	22	38
DUSSELDORF EXPRESS	47	
DYUI SKAGERAK	6	21
DYVI KATTEGAT	10	123
E.R. BRUSSEL	14	
EASTERN FRIENDSHIP	10	56
EASTERN GLORY	14	64
EASTERN GRACE		54
EASTERN ROYAL	72	19
ELBE MARU	143	
ELGAREN	126	
ENDEAVOR	13	42
ERNEST R. BREECH	2	3
ESTHER SCHULTE	30	
EVER GATHER		9
EVER GENIUS	2	
EVER GIANT	9	103
EVER GIFTED	4	6
EVER GIVEN	34	52
EVER GLEAMY	5	
EVER GLOBE	3	16
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EVER GRACE	34	56
EVER GRADE	10	
EVER GRAND	9	13
EVER GROUP	25	45
EVER GROWTH		7
EVER GUEST	9	69
EVER GUIDE	2	
EVER LAUREL	9	19
EVER LEVEL	29	20
EVER LINKING	1	
EVER LIVING	7	9
EVER LOADING	19	64
EVER LYRIC	9	7
EVER SHINE	31	
EVER SUMMIT	35	68
EVER SUPERB	16	12
EVER TRUST	23	26
EVER VALOR	28	192
EVER VIGOR	26	
EVER VITAL	12	47
EVERSPRING	4	17
EXPORT CHALLENGER	37	123
EXPORT CHAMPION	38	113
EXPORT FREEDOM	41	81
EXPORT PATRIOT	49	101
EXXON BALTIMORE	5	1
EXXON BATON ROUGE	27	62
EXXON BAYTOWN	22	44
EXXON BENICIA	30	63
EXXON BOSTON	43	154
EXXON HOUSTON	39	63
EXXON JAMESTOWN	13	16
EXXON LEXINGTON	13	18
EXXON NEW ORLEANS	26	106
EXXON NORTH SLOPE	28	44
EXXON PHILADELPHIA	2	48
EXXON PRINCETON	23	54
EXXON SAN FRANCISCO	4	17
EXXON VALDEZ	6	15
EXXON WASHINGTON	24	32
FALCON LEADER	14	21
FALSTAFF	4	19
FALSTRIA	68	111
FEDERAL FRASER	30	72
FEDERAL LAKES	20	58
FEDERAL SEAWAY	33	76
FERNCROFT	107	165
FIRST LT JACK LUMMUS	15	
FLORIDA RAINBOW	27	67
FORTALEZA	120	208
FRANCIS SINCERE NO. 6	40	
FRANKFURT	1	
FROTASIRIUS	31	
GALLEON AQUAMARINE	16	
GALVESTON	44	84
GAZANIA	30	
GEMINI	68	128
GENERAL M.BELGRANDO	12	
GENEVIEVE LYKES	1	15
GENISTA	1	
GEORGE WASHINGTON BRID	61	43
GERONIMO		11
GLACIER BAY	6	69
GLOBAL FRONTIER	62	122

SHIP NAME	VIA RADIO	VIA MAIL
GLOBAL PIONEER	33	43
GLOBAL SPLENDOR	36	92
GLORIOUS SPICA	29	
GLORY SPIRIT	22	
GOLDEN APO	19	
GOLDEN BEAR	48	
GOLDEN BLISS	57	
GOLDEN GATE BRIDGE	63	72
GOLDEN HAWK	25	84
GOLDEN HILL	39	52
GREAT LAND	175	208
GREAT OCEAN	76	36
GREEN FOREST	37	34
GREEN HARBOUR	48	
GREEN ISLAND	37	54
GREEN KOBE	1	14
GREEN MASTER	51	58
GREEN MAYA	28	49
GREEN RAINIER	8	29
GREEN SASEBO	98	68
GREEN STAR	24	27
GREEN VALLEY	44	93
GREEN WAVE	28	95
GUAICURI	43	
GULF IDEAL	26	
GYPSUM COUNTESS	151	37
GYPSUM KING	279	
H.J. HAYNES		227
HAKUSAN	23	43
HAKUSAN MARU	111	
HANJIN BUSAN	10	15
HANJIN HONG KONG	3	8
HANJIN KOBE	15	41
HANJIN KWANGYANG	16	
HANJIN LONG BEACH	9	24
HANJIN POHANG	23	20
HANJIN SEOUL	2	
HASSAN MERCHANT	125	40
HERMENIA	72	89
HIKAWA MARU	153	
HIRA MARU	123	
HIYOSHI MARU	56	
HOEGH CAIRN	18	37
HOEGH CLIPPER	12	
HOEGH DRAKE		54
HOEGH DUKE	102	
HOEGH DYKE		24
HOEGH MARLIN	13	
HOEGH MASCOT	9	165
HOEGH MINERVA	32	68
HOEGH MIRANDA	16	75
HOHSING BREEZE	36	54
HOLIDAY		150
HONOLULU	77	
HRELJIN	11	
HYUGA MARU	62	
HYUNDAI #1	22	36
HYUNDAI #18	13	
HYUNDAI #7	9	13
HYUNDAI CHALLENGER		142
HYUNDAI CON SIX	1	
HYUNDAI EXPLORER	13	106
HYUNDAI INNOVATOR		58
HYUNDAI PIONEER	12	31
INCOTRANS PACIFIC	32	
INGER	49	130
IRVING ARCTIC	126	
IRVING MIAMI	51	
ISLAND HOPE		131
ISLAND PRINCESS	158	
ITALICA	25	
J.T. HIGGINS		206
JADRAN	11	
JALAMOKAMBI	1	
JALAVIHAR	25	
JALAVIJAYA	2	
JALISCO	23	
JAMES LYKES	13	
JAPAN ALLIANCE	62	22
JAPAN APOLLO	69	48
JEAN LYKES	18	63
JOHN A. MCCONE		182
JOSEPH LYKES	31	
JOVIAN LILY	52	109
JOVIAN LUZON	21	41
JUBILEE	24	19
KALAYAAN	81	106
KALIDAS	77	115
KAMNIK	1	
KASINA	56	39
KASTURBA	50	22
KAUAI	62	197
KEE LUNG	19	
KEN TRADER	66	101
KENAI		75
KENNETH E. HILL	14	44
KENNETH T. DERR	21	83
KENT	51	95
KEYSTONE CANYON	15	170
KEYSTONER	47	169
KISO MARU	65	
KITTANNING	1	12
KOFUKU MARU	44	65
KOLN EXPRESS	44	
KOREAN JACEWON	28	11
KOREAN WONIS JIN	36	76
KOREAN WONIS ONE	15	8
KOREAN WONIS SEVEN	18	38
KOREAN WONIS SUN	16	24
KUROBE MARU	95	
LA PAMPA	18	
LANAI	36	
LANCASHIRE	1	
LARS MAERSK	38	117
LAURA MAERSK	25	38
LAUST MAERSK	11	101
LAWRENCE A. GIANELLA	64	191
LEDA MAERSK	27	64
LEISE MAERSK	27	93
LERMA	109	98
LESLIE LYKES	28	
LETITIA LYKES	21	35
LEXA MAERSK	23	66
LIBERTADOR GRAL SAN MA	22	28
LICA MAERSK	59	66
LILLOOET	48	52
LILLY STAR	2	
LING LEO	40	204
LLOYD ALTAMIRAP	1	
LNG TAURUS		10
LONG BEACH	17	58
LOTUS ACE	71	
LOUIS MAERSK	23	86
LOUISE LYKES	86	112
LPG HARDANGER		199
LT. ODYSSEY	5	24
LUCENT STAR	92	86
LURLINE	93	210
LUZON	29	99
LUZON VICTORY	4	
M. P. GRACE	23	
M.T. NILE	1	124
MADANG	8	
MAERSK WAVE	38	132
MAJ SANDVED	40	73
MAJ. STEPHEN W. PLESS	4	
MALLORY LYKES	1	
MANGAL DESAI	52	
MANHATTAN	11	
MANUKAI	85	193
MANULANI	60	181
MARABANK	8	7
MARATHA MARINER	22	
MARATHA MELODY	110	
MARATHA SHOGUN	30	
MARCHEN MAERSK	1	
MARCHIONESS	43	
MARGARET LYKES	95	173
MARIA TOPIC	15	85
MARIF	33	
MARITIME NOBLE	123	
MARJORIE LYKES	40	22

SHIP NAME	VIA RADIO	VIA MAIL
MAUI	73	213
MC KINNEY MAERSK	20	67
MEDALLION	44	
MEDUSA CHALLENGER	11	34
MEGHAN	2	11
MELBOURNE HIGHWAY	12	9
MENINA BARBARA	46	
MERAK EIGHTY	21	
MERIDA	34	36
MICROBA	16	
MICRONESIAN COMMERCE	17	26
MICRONESIAN INDEPENDEN	156	140
MILTA	21	122
MING GLORY	12	20
MING MOON	8	37
MING OCEAN	20	40
MING PROPITIOUS	7	
MING SPRING	20	
MING STAR	3	7
MING SUN	4	37
MOANA PACIFIC	134	141
MOBIL ARCTIC	58	212
MOBIL MERIDIAN	69	190
MOKU PAHU	56	213
MORMACSKY	17	60
MORMACSTAR	9	23
MORMACSUN	2	19
MOSEL EXPRESS	116	
MOUNT WASHINGTON	7	
MV TRUDY	79	22
NANCY LYKES	9	
NATIONAL DIGNITY	29	95
NATIONAL HONOR	25	103
NATIONAL PRIDE	20	
NAVIGATOR		185
NAVIOS ENTERPRISE	21	
NEASHO		1
NEDLLOYD ELBE	90	
NEDLLOYD KATAJK	122	
NEDLLOYD KEMBLA	82	
NEDLLOYD KIMBERLEY	95	
NEDLLOYD KINGSTON	100	
NEDLLOYD KYOTO	107	
NEDLLOYD ROCHESTER	114	
NEDLLOYD ROSARIO	78	
NEDLLOYD ROTTERDAM	118	
NEDLLOYD ROUEN	113	
NEPTUNE ACE	185	
NEPTUNE AMBER	52	217
NEPTUNE CORAL	73	172
NEPTUNE DIAMOND	256	134
NEPTUNE GARNET	59	
NEPTUNE IVORY	77	
NEPTUNE KIKU	17	
NEPTUNE PEARL	80	179
NEPTUNE TOURMALINE	39	
NEPUNE CYPRINE	13	
NEW HORIZON		53
NEW INDEPENDENCE	77	160
NEW JERSEY MARU	113	
NEW YORK MARU	115	
NEWARK	1	
NISSAN MARU	48	
NOAA DAVID STARR JORDA	84	171
NOAA SHIP ALBATROSS IV	48	
NOAA SHIP CHAPMAN	135	177
NOAA SHIP DAVIDSON	3	
NOAA SHIP DELAWARE II	101	74
NOAA SHIP FERREL		129
NOAA SHIP JOHN N COBB	58	56
NOAA SHIP MILLER FREEM	411	377
NOAA SHIP MT MITCHEL	131	205
NOAA SHIP OREGON II	92	168
NOAA SHIP RESEARCHER	115	169
NOAA SHIP SURVEYOR	46	
NOAA SHIP T. CROMWELL	330	490
NOAA SHIP WHITING	116	218
NOORDAM	70	
NORDHVAL	123	121
NORWAY	6	35
NOSAC EXPRESS	6	38
NOSAC SEL	94	172
NOSAC TAKARA	20	
NOSAC TAKAYAMA	179	115
NOSAC TRIGGER	14	
NOSAC VERDE	17	109
NURNBERG EXPRESS	48	
OAK GLORY	18	77
OAK PEARL	69	40
OAK SUN	67	
OAKLAND	179	175
OBERON	21	
OCEAN BRIDGE	5	
OCEAN CHEER	12	10
OCEAN COMMANDER #1	12	26
OCEAN DIANA	26	
OCEAN LEGEND	15	9
OCEAN STEELHEAD	89	215
OCTA	36	26
OHTORI		16
OJI GLORIA	72	
OLEANDER	118	156
OLGA TOPIC	16	
OLIVE ACE	27	66
OMI DYNACHEM	23	62
ORANGE ACE	56	23
ORCHID #2	18	56
OREGON RAINBOW	26	75
ORIENTAL DIPLOMAT	67	27
ORIENTAL EDUCATOR	105	244
ORIENTAL EXECUTIVE	48	200
ORIENTAL EXPLORER	73	168
ORIENTAL FAIR	7	15
ORIENTAL FORTUNE	19	49
ORIENTAL KNIGHT	30	27
ORIENTAL MINISTER	2	
ORIENTAL PATRIOT	34	51
ORIENTAL PHOENIX	3	280
ORIENTAL PRINCE	152	
ORIENTAL TAIO	57	
ORION HIWAY	84	146
OVERSEAS ALICE	10	66
OVERSEAS BOSTON	24	
OVERSEAS CHICAGO	8	27
OVERSEAS JUNEAU	37	164
OVERSEAS MARILYN	4	20
OVERSEAS OHIO	37	159
OVERSEAS VALDEZ	28	12
OVERSEAS VIVIAN	17	48
OVERSEAS WASHINGTON	60	113
PACBARON	16	
PACBARONESS	25	9
PACDUCHESS	27	11
PACDUKE	8	
PACEMPEROR	27	18
PACGLORY	11	
PACIFIC ANGEL	55	72
PACIFIC ARROW	84	69
PACIFIC CLIPPER	26	
PACIFIC DOWN	24	187
PACIFIC HIGHWAY	182	98
PACIFIC PRINCESS	52	
PACIFIC PROGRESS		12
PACIFIC RAINBOW	65	87
PACIFIC VENTURE	158	
PACIFIC VICTORY	27	3
PACIFIC WING	47	
PACKING	27	
PACMAJESTY	18	
PACMERCHANT	15	
PACMONARCH	28	
PACNOBLE	21	
PACPRINCE	20	33
PACPRINCESS	43	62
PALM ACE	75	
PANAMA	14	98
PANCALDO	11	29
PATRIOT	3	50
PAUL BUCK	61	48
PAUL PIGOTT	1	
PAYSANDU	1	
PECOS	35	15

SHIP NAME	VIA RADIO	VIA MAIL
PEGGY DOW	61	
PENNSYLANIA RAINBOW	1	181
PENNSYLVANIA TRADER	2	13
PERUVIAN REEFER		82
PETERSBURG	29	36
PETERSFIELD	106	
PFC EUGENE A. OBREGON	15	8
PFC WILLIAM B. BAUGH	10	50
PFC. JAMES ANDERSON JR	23	55
PHILADELPHIA	69	48
PHILIPPINE VICTORY	17	74
PILAR	18	57
PLANTIN	73	
POLAR ALASKA	9	146
POLYNESIA	186	272
PONCE	16	2
POQUITA MAMI	43	7
POTOMAC TRADER	43	112
PRESIDENT CLEVELAND	4	
PRESIDENT EISENHOWER	144	196
PRESIDENT F. ROOSEVELT	56	160
PRESIDENT FILLMORE	29	71
PRESIDENT GRANT	17	52
PRESIDENT HOOVER	44	140
PRESIDENT JACKSON	11	
PRESIDENT JEFFERSON	61	134
PRESIDENT JOHNSON	68	90
PRESIDENT KENNEDY	9	35
PRESIDENT LINCOLN	13	177
PRESIDENT MADISON	43	246
PRESIDENT MC KINLEY	72	249
PRESIDENT PIERCE	85	355
PRESIDENT TAFT	1	
PRESIDENT TAYLOR	25	91
PRESIDENT TYLER	45	100
PRESIDENT VAN BUREN	8	23
PRESIDENT WASHINGTON	115	189
PRESIDENT WILSON	25	
PRIDE OF TEXAS	11	
PRINCE OF TOKYO	74	237
PROSPERIDAD	43	102
PUNTA BRAVA	2	4
PVT HARRY FISHER	13	
QUATSINO SOUND	49	98
QUEEN OPAL	60	53
QUEENS WAY BRIDGE	126	
RADIANT VENTURE		25
RADWAN-PANAMA	46	82
RAINBOW BRIDGE	103	55
RAINBOW HOPE		316
RED ARROW	44	
REGINA MAERSK	27	120
RHEIN EXPRESS	118	
RICHARD G MATTIESEN	34	
RIMBA SEPETIR	5	
RIO ESQUEL	28	17
RIO FRIO	8	
RIO GRANDE	1	
RIO LIMAY	17	
RIO TEUCO	2	
ROACHBANK	53	
ROBERT CONRAD	33	44
ROBERT E. LEE	22	
RODIN	50	
ROGER R. SIMONS	5	17
ROSARIO DEL MAR	7	33
ROSINA TOPIC	14	45
ROSTAND	99	
ROTTERDAM	34	
ROUSSEAU	167	
ROYAL PRINCESS	64	
ROYAL VIKING SKY	16	
RUTH LYKES	4	63
RV WELCOMA		96
S.S. ROVER	15	133
SAM HOUSTON	17	
SAMOAN REEFER	133	235
SAMRAT ASHOK	1	
SAN JUAN	96	173
SAN MATEO VICTORY	16	
SAN PEDRO	63	162
SANKO CYRSTAL	13	46
SANKO DIGNITY	9	
SANKO ETERNITY	8	
SANKO GRACE	14	18
SANKO HAWK	36	16
SANKO HELIANTHUS	13	
SANKO LAPIS	8	70
SANKO LILY	30	
SANKO PEACE	95	93
SANKO PEACOCK	12	
SANKO PEARL	38	
SANKO RELIANCE		12
SANKO STAR	18	
SANKO SWIFT	18	80
SANKO TURQUOISE	8	9
SANSINENA II	27	100
SANTA ADELA	88	120
SANTA CRUZ II	1	
SANTA JUANA	68	183
SATURN DIAMOND	47	
SAUDI DIRIYAM	57	
SAVANNAH	130	
SAVONITA	35	206
SCANDINAVIAN HIGHWAY	196	
SEA BELLS	38	42
SEA DIAMOND	48	127
SEA FAN	52	73
SEA FORTUNE	38	120
SEA HAVEN		25
SEA JADE	66	20
SEA LANTERN	50	95
SEA LIGHT	75	92
SEA TRANSPORTER	79	
SEALAND ADVENTURER	102	154
SEALAND BOSTON	57	79
SEALAND CONSUMER	60	126
SEALAND DEFENDER	94	188
SEALAND DEVELOPER	82	207
SEALAND ECONOMY	54	144
SEALAND ENDURANCE	52	149
SEALAND EXPLORER	46	168
SEALAND EXPRESS	73	192
SEALAND FREEDOM	50	124
SEALAND INDEPENDENCE	54	147
SEALAND INNOVATOR	66	185
SEALAND LEADER	66	200
SEALAND LIBERATOR	65	148
SEALAND MARINER	39	83
SEALAND PACER	40	160
SEALAND PATRIOT	38	129
SEALAND PIONEER	48	130
SEALAND PRODUCER	67	122
SEALAND VENTURE	78	166
SEALAND VOYAGER	90	150
SEDCO/BP 471	38	111
SEVEN OCEAN	29	72
SGT WILLIAM R BUTTON	28	
SGT. METEJ KOCAK	4	19
SHELDON LYKES	88	81
SHELLY BAY	18	
SHIN BEISHU MARU	24	
SHINKASHU MARU	56	
SHIRLEY LYKES	46	
SILVER CLIPPER	28	
SILVER STAR	62	121
SINGAPORE VICTORY		9
SIOUX TATE	26	
SKAUBORD	20	44
SKAUGRAN	40	117
SKOUBORD	41	63
SKRIM	145	
SOARER CUPID	29	106
SOARER DIANA	7	67
SOLON TURMAN	5	
SONORA		44
SOPHIA	87	
SOUTHLAND STAR	141	
SPIRIT OF LIBERTY	33	78
SPRING BEAR	116	
SPRING BIRD	22	13
SPRING BREEZE		121

SHIP NAME	VIA RADIO	VIA MAIL
SS MAUNALEI	31	133
STAR DENVER	1	
STAR DIEPPE	49	
STAR DOVER	5	10
STAR EAGLE	15	49
STAR GRAN	14	86
STAR HONGKONG	89	
STAR KANDA	17	16
STAR OF TEXAS	93	94
STAR THAILAND	35	85
STARWARD	29	47
STELLA LYKES	5	
STONEWALL JACKSON	23	32
STRATHCONON	85	
STUTTGART EXPRESS	42	
SUGAR ISLANDER	2	178
SUN PRINCESS	1	
SUN VIKING	17	9
SUNBELT DIXIE	167	138
SUNORA	66	71
SUNSET PEAK	22	
SYOSSET	7	22
TABASCO	52	35
TAI CORN	41	39
TAI LIENG	1	
TAI SHING	1	
TARGET	104	113
TENCHBANK	79	
TEPOZTLAN	30	
TESTER	94	114
TEXACO FLORIDA	2	
TEXACO GEORGIA	15	69
TEXACO GHENT	1	
TFL ENTERPRISE	26	53
TFL FREEDOM	60	129
TFL INDEPENDENCE	34	129
TFL ITALY	62	
TFL JEFFERSON	3	
TFL LIBERTY	42	172
THOMAS G. THOMPSON	51	
THOMAS WASHINGTON	48	109
THOMPSON LYKES	37	58
THOMPSON PASS	2	128
TOHBEI MARU	68	28
TOKYO MARU	32	
TOKYO RAINBOW	63	82
TONCI TOPIC	6	148
TONSONIA	30	144
TOWER BRIDGE	21	
TOYOTA MARU 15	22	
TOYOTA MARU NO 17	43	
TOYOTA MARU NO 18	60	
TRAVE ORE	60	20
TROPICAL BEAUTY	13	
TUNISIAN REEFER	16	47
TYSON LYKES	20	89
ULTRAMAR	21	58
ULTRASEA	1	60
UNAMONTE	10	
UNI-MASTER	1	
UNICORN		274
UNITED HOPE	44	79
UNITED SPIRIT	29	54
USCGC ACTIVE WMEC 618	18	
USCGC ALERT (WMEC 630)	20	
USCGC BASSWOOD (WLB 38	9	
USCGC BLACKHAW (WLB 39	13	
USCGC BOUTWELL WHEC 71	150	140
USCGC BUTTONWOOD WLB 3	4	
USCGC CHASE (WHEC 718)	4	115
USCGC CHEROKEE WMEC 16	23	101
USCGC CHILULA (WMEC 15	14	
USCGC CLOVER (WMEC 292	1	
USCGC COURAGEOUS	10	
USCGC DEPENDABLE	16	
USCGC FIREBUSH WLB 393	4	
USCGC GLACIER (WAGB 4)	189	143
USCGC HARRIET LANE	6	
USCGC INGHAM (WHEC 35)	17	
USCGC IRONWOOD (WLB 29	74	
USCGC JARVIS (WHEC 725	57	
USCGC KATMAI BAY	6	29
USCGC LIPAN (WMEC 85)	1	
USCGC MACKINAW	48	
USCGC MALLOW (WLB 396)	21	
USCGC MIDGETT (WHEC 72		66
USCGC MORGENTHAU	27	
USCGC NORTHLAND WMEC 9	4	
USCGC NORTHWIND WAGB 2	9	12
USCGC PLANETREE WLB 30	26	
USCGC POLAR SEA WAGB 1	36	117
USCGC RESOLUTE WMEC 62	18	
USCGC RUSH (WHEC 723)		103
USCGC SALVIA (WLB 400)	5	
USCGC SEDGE (WLB 402)	12	
USCGC STORIS (WMEC 38)	19	167
USCGC SWEETBRIER WLB 4	33	12
USCGC TAMAROA (WMEC 16	1	8
USCGC TAMPA WMEC 902	4	
USCGC UNIMAK (WTR 379)	9	
USCGC VIGILANT WMEC 61	18	
USCGC VIGOROUS WMEC 62	6	
USCGC WOODRUSH (WLB 40	18	3
USCGC YOCONA (WMEC 168	177	232
USNS APACHE (T-ATF 172	15	35
USNS BARTLETT(T-AGOR 1	3	35
USNS CHAUVENET	55	80
USNS DE STEIGUER	1	80
USNS GUS W. DARNELL	48	
USNS HARKNESS (T-AGS 3	7	24
USNS KAWISHIWI	3	
USNS MERCURY	57	180
USNS MISSISSINEWA		71
USNS MOHAWK (T-ATF 170	22	41
USNS NARRAGANSETT	19	34
USNS NEOSHO (T-AO 143)		84
USNS PASSUMPSIC TAO 10		30
USNS PAWCATUCK TAO-108		163
USNS POLLUX	19	
USNS PONCHATOULA	27	110
USNS POWHATAN TATF 166	61	92
USNS RANGE SENTINEL	3	
USNS SATURN T-AFS-10		88
USNS SEALIFT ANTARCTIC	20	98
USNS SEALIFT ARABIAN S	1	15
USNS SEALIFT ARCTIC	31	72
USNS SEALIFT ATLANTIC	3	
USNS SEALIFT CARIBBEAN	6	
USNS SEALIFT CHINA SEA	26	55
USNS SEALIFT IND'N OCE	13	18
USNS SEALIFT MED	32	62
USNS SEALIFT PACIFIC	8	22
USNS SILAS BENT T-AGS	94	115
USNS SPICA (T-AFS 9)		48
USNS VANGUARD TAG 194	78	184
VALLEY FORGE	32	104
VAN FORT	1	
VAN TRADER	70	65
VELENJE	10	
VERRAZANO BRIDGE	22	18
VICTORY ACE	25	
VISHVA PANKAJ	77	109
VISHVA PAROG	5	
VISHVA PRAFULLA	8	128
VISHVA SIDDHI	2	
VISHVA TIRTH	1	
VISHVA VIKRAM	11	
WALCHAND	2	
WASHINGTON RAINBOW #2	70	186
WELLINGTON STAR	144	
WESER EXPRESS	35	
WESTERN HIGHWAY	45	
WESTERN SUN	21	46
WESTOCEAN	257	
WESTWARD VENTURE	51	57
WESTWOOD MARIANNE	7	49
WESTWOOD MERCHANT		14
WILFRED SYKES	3	5
WILLIAM CLAY FORD		12
WILLIAM E. MUSSMAN	19	221
WILLOWBANK	47	
WORLD WING #2	115	

SHIP NAME	VIA RADIO	VIA MAIL
YAMASHIN MARU	113	77
YOUNG SCOPE	90	
YOUNG SKIPPER	69	25
YOUNG SPORTSMAN	23	57
YOUNG SPROUT	88	129
YS ARGOSY	50	160
ZAPATA ARCTIC		7
ZAPATA COURIER	58	
ZEELANDIA	41	
ZENIT WATER	21	45
ZEUS	4	
ZIM GENOVA	38	
ZIM HAIFA	14	
ZIM HONGKONG	44	
ZIM HOUSTON	5	
ZIM IBERIA	48	
ZIM KEELUNG	24	
ZIM MARSEILLES	20	
ZIM MIAMI	9	
ZIM NEW YORK	27	
ZIM SAVANNAH	43	
ZIM TOKYO	37	

SUMMARY: GRAND TOTAL VIA RADIO 38546
GRAND TOTAL VIA MAIL 53224
TOTAL UNIQUE OBS 75322
TOTAL DUPLICATES 16448 (21.8%)
UNIQUE RADIO OBS.22098 (29.3%)
UNIQUE MAIL OBS. 36776 (48.8%)

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Selected Gale and Wave Observations

January, February and March 1987

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves*		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.°	Height ft.
	PACIFIC	JAN.															
KASINA	3FJD2	2	39.4 N	168.9 E	00	24	M 50	2 NM	79	0981.0	8.0	10.0	8	16.5	20	12	32.5
EVER VALOR	PKHW	2	35.0 N	159.3 E	00	29	M 51	2 NM		1003.0	8.5	16.0	12	16.5	31	16	29.5
KASINA	3FJD2	2	39.6 N	170.4 E	06	24	M 50	2 NM	79	0977.5	9.0		9	16.5	24	14	31
LUCENT STAR	6ZBM	2	42.4 N	165.2 E	18	30	M 56	1 NM	60	0984.0	2.0	7.0	8	23	32	12	29.5
BROOKLYN	KGDB	2	48.5 N	133.3 W	18	14	48	2 NM	63	0985.4	7.8	11.2	3	14.5	28	12	29.5
PRESIDENT WASHINGTON	WHPN	2	51.5 N	165.6 E	18	05	M 45	1 NM	22	0983.5	- 1.1	4.4	10	16.5	06	14	29.5
LUCENT STAR	6ZBM	3	42.0 N	166.6 E	00	30	M 50	.5 NM	40	0987.0	3.5	7.0	8	23	31	12	29.5
EVER VALOR	PKHW	3	34.7 N	166.8 E	00	30	M 47	5 NM		1005.5	11.0	17.0	12	13	31	16	29.5
ACE ACCORD	DULV	3	52.6 N	169.7 E	00	02	M 47	1 NM	87	0981.0	0.0		10	29.5			
SEALAND DEFENDER	KGJB	3	34.0 N	171.3 E	00	29	M 48	2 NM	27	1001.3	10.5	14.0	3	14.5	30	9	37.5
LARS MAERSK	OXMD	3	49.9 N	166.9 E	00	04	M 45	5 NM	83	0976.0	3.0	3.2	10	31			
KENT	3EPF3	3	51.7 N	167.5 E	06	02	M 48	2 NM	72	0986.0	1.0	4.0	10	26	02	XX	29.5
LUCENT STAR	6ZBM	3	41.8 N	168.3 E	06	30	M 52	2 NM	68	0989.0	3.0	8.0	8	23	31	12	29.5
GREAT LAND	WFDP	3	51.1 N	131.8 W	06	13	M 50			0967.0	8.3	7.2	3	6.5	15	4	34.5
LUCENT STAR	6ZBM	3	41.5 N	169.8 E	12	31	M 55	1 NM	68	0993.0	3.8	8.0	8	23	31	12	29.5
BROOKLYN	KGDB	3	45.4 N	130.3 W	12	29	45	10 NM		0993.6	8.4	13.4	3	18	29	12	31
SKOUBORD	LION	4	40.3 N	144.3 E	00	29	M 53	1 NM	26	1007.0	1.0	8.0	15	31			
	WTST	4	53.3 N	175.5 E	12	28	M 50	1 NM	85	0973.5		3.3	9	24.5	29	14	29.5
	WTST	4	53.3 N	174.9 E	18	29	M 45	.25 NM	88	0975.4		4.0	15	32.5	33	14	29.5
SEALAND EXPLORER	WGJF	6	36.1 N	158.0 E	09	30	M 45	10 NM	03	1013.5	15.0		8	24.5	30	15	29.5
NATIONAL DIGNITY	DZPG	9	52.7 N	150.7 W	00	23	M 49	5 NM	50	0973.0	5.0	5.0	12	16.5	28	21	29.5
NATIONAL DIGNITY	DZPG	10	53.7 N	156.3 W	00	29	M 48	50 YD	77	0991.5	- 2.0	3.0	12	16.5	30	21	29.5
	WSIN	10	56.5 N	148.0 W	18	25	45	5 NM	26	0997.0	- 2.2	5.5	6	19.5	27	10	41
SEALAND INNOVATOR	WGKF	11	36.0 N	155.4 E	06	28	M 50	5 NM	25	1003.6	7.5	16.0	7	21	28	10	29.5
	WSKJ	13	29.8 N	129.2 E	06	31	M 70	5 NM	89	1019.5	8.5	21.1	8	23	31	10	32.5
	WSKJ	13	30.0 N	129.4 E	09	32	M 51	5 NM	89	1017.0	8.5	21.2	8	19.5	31	12	29.5
ORIENTAL MINISTER	ELDK3	14	43.1 N	169.3 E	06	24	48	.5 NM	52	0970.8	5.4	8.0	11	31	23	23	29.5
CHASTINE MAERSK	OWCY	14	43.7 N	175.8 W	06	18	46	1 NM	60	0990.0	8.0		4	16.5	18	8	29.5
ORIENTAL MINISTER	ELDK3	14	43.4 N	171.4 E	12	24	45	.5 NM	54	0972.0	5.3	8.0	XX	31	23		29.5
PRESIDENT TAYLOR	WJGH	14	54.0 N	172.0 W	19	10	55	5 NM		0965.0	1.1	3.3	8	24.5	16	9	34.5
PRESIDENT JEFFERSON	WSIN	23	59.4 N	147.9 W	00	09	45	2 NM	63	0980.0	6.1	4.4	5	16.5	18	10	29.5
PRESIDENT JEFFERSON	WPGE	26	51.4 N	162.4 E	00	26	M 55	5 NM	22	0962.5	2.8	1.7	13	24.5	28	10	29.5
PRESIDENT JEFFERSON	WPGE	26	50.6 N	161.0 E	06	26	M 80	2 NM	86	0972.0	- 1.4	1.7	17	34.5	29	15	24.5
PRESIDENT JEFFERSON	WPGE	26	50.5 N	160.7 E	12	26	M 65	2 NM	85	0977.2	- 2.2	1.7	18	36	29	15	29.5
PRESIDENT JEFFERSON	WPGE	26	50.4 N	160.1 E	18	26	M 64	2 NM	85	0979.0	- 3.1	1.7	20	37.5			
PRESIDENT JEFFERSON	WPGE	27	49.7 N	159.7 E	00	26	M 60	2 NM	72	0986.0	- 4.4	1.7	20	37.5	24	15	41
PRESIDENT JEFFERSON	WPGE	27	48.2 N	159.1 E	06	26	M 60	2 NM	87	0993.5	- 5.6	1.1	15	36	29	20	32.5
SEALAND DEFENDER	KGJB	27	45.3 N	165.1 W	18	23	M 48	2 NM	07	0974.3	4.5	3.0	5	16.5	24	8	31
SEALAND FREEDOM	WGJW	29	46.6 N	171.8 W	00	27	M 50	5 NM	02	0983.4	1.3	3.0	10	19.5	27	19	32.5
	WSIN	30	48.2 N	133.4 W	18	18	45	5 NM		0992.4	9.4	7.6	8	26	27	10	32.5
	WSIN	30	48.0 N	133.2 W	20	16	55	1 NM	65	0989.0	8.3	8.9	7	19.5	18	9	36
	WSIN	30	48.0 N	132.9 W	23	30	60	1 NM	81	0986.0	6.1	9.4	10	49	XX	11	59
HANJIN POHANG	D8ON	31	45.1 N	151.6 E	00	25	M 55	.5 NM	73	1000.0		5.0	20	23	25	24	32.5
	WSIN	31	47.4 N	132.2 W	06	28	45	10 NM	02	1000.0	7.2	9.4	7	23	23	9	32.5
	ATLANTIC	FEB.															
EXXON NEW ORLEANS	WNDM	4	52.3 N	176.7 W	00	13	52	5 NM		0983.5	9.0	7.2	5	6.5	19	16	31
B.T. ALASKA	WFGE	4	50.0 N	134.8 W	06	15	M 51	5 NM		0979.2	7.8	7.8	3	10	22	14	32.5
ORIENTAL MINISTER	ELDK3	4	34.8 N	174.2 E	18	27	45			0992.5	13.0	14.0	8	44	27	8	44
LUZON	7ESJ7	8	39.5 N	164.5 E	00	24	M 58	50 YD	04	0971.0	6.0	10.0	12	19.5	24	30	42.5
LUZON	7ESJ7	8	40.1 N	166.4 E	06	25	M 59	< 50 YD	98	0974.0	7.0	10.0	8	10	25	20	39
CHESAPEAKE TRADER	WGZK	12	50.9 N	129.7 W	12	14	45	2 NM	62	0997.4	8.3		7	19.5	14	14	46
PRESIDENT WASHINGTON	WHPN	13	52.2 N	167.1 E	12	26	M 45	5 NM	24	0978.0	- 2.8	3.9	9	14.5	18	12	32.5
REGINA MAERSK	OXSR	13	47.7 N	157.4 E	18	27	55	2 NM	86	0991.5	- 5.6		11	39			
NEPTUNE PEARL	9GBY	17	49.7 N	158.6 E	18	25	M 55	.5 NM	72	0978.0	- 2.5	6.0	6	16.5	24	7	32.5
NEPTUNE PEARL	9GBY	18	49.2 N	157.7 E	00	28	M 48	.25 NM	72	0989.0	- 3.5	1.0	7	16.5	29	9	32.5
PRESIDENT WASHINGTON	WHPN	18	50.6 N	163.8 E	06	26	M 47	200 YD	86	0980.0	- 2.8	2.2	9	19.5	26	13	44
LAURA MAERSK	OYBF	15	44.4 N	175.2 E	18	24	45	.5 NM	70	0990.0	0.0		18	29.5			
LAURA MAERSK	OYBF	16	44.6 N	177.3 E	00	25	45	1 NM	70	0994.0	1.8		18	29.5			
LAURA MAERSK	OYBF	16	45.0 N	179.4 E	06	27	45	2 NM	70	0993.0	1.0		18	29.5			
VAK TRADER	3EPG4	17	49.8 N	154.0 W	18	25	M 65	.5 NM		0992.0	4.0	5.0	16	32.5	21	20	29.5
PRESIDENT EISENHOVER	KRJG	19	53.2 N	150.3 W	03	27	M 55			0992.5	4.0	4.6	6	16.5	27	6	31
HYUNDAI #1	D8PT	21	52.9 N	142.4 W	00	27	M 50	10 NM		1019.0	8.0	6.0	10	24.5	27	13	32.5
PRESIDENT LINCOLN	KDRG	22	37.5 N	128.2 W	06	25	48	5 NM	02	1026.4	10.6	14.4	3	16.5	34	7	29.5
HYUNDAI #1	D8PT	23	53.7 N	155.9 W	00	18	M 45			1006.0	8.0	5.0	10	24.5	18	12	29.5
KASINA	7FJD2	25	48.1 N	178.5 W	06	11	M 50	2 NM	61	1012.0	4.0	3.0	9	24.5	13	13	36

Selected Gale and Wave Observations, cont'd

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C.		Sea Waves†		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
	PACIFIC	MAR.															
BARBER TEXAS	LMWR	2	37.0 N	156.6 E	06	24	M 48	5 NM	15	0995.0	17.0	14.0	6	10	26	16	42.5
BARBER TEXAS	LMWR	2	37.3 N	159.1 E	12	26	M 49	5 NM	00	1000.0	9.0	14.0			25	15	41
SEALAND LIBERATOR	KHRP	7	44.0 N	158.8 E	06	28	M 51	5 NM	22	0988.0	0.7		4	11.5	28	8	29.5
ALTAMONTE	DZBD	11	43.6 N	175.6 E	06	27	M 60	200 YD			3.0	10.0	5	10	26	6	29.5
GALVESTON	KBGA	22	56.7 N	146.9 W	00	14	50	5 NM		0993.0	4.4	5.6	6	26	14	7	29.5
MC KINNEY MAERSK	OWEQ	31	42.3 N	156.9 W	00	32	65	.25 NM	62	0989.5	6.0				12	25	41
	ATLANTIC	JAN.															
ALLEMAGNA EXPRESS	ITCN	2	35.8 N	47.7 W	06	31	M 45	5 NM	03	1013.5	14.0	18.0	10	19.5	31	15	29.5
CHELSEA	KNCX	2	39.5 N	68.8 W	15	22	50	5 NM	07	0989.7	16.9	21.1	6	16.5	22	10	31
CHELSEA	KNCX	2	40.2 N	68.8 W	19	25	50	2 NM	07	0993.0	11.7	12.8	6	29.5	25	8	24.5
EXPORT FREEDOM	WCJS	19	37.3 N	57.8 W	18	25	60	5 NM	02	1007.0	21.1	20.6	8	16.5	25	8	36
EXPORT FREEDOM	WCJS	20	37.1 N	59.9 W	06	23	60	5 NM	03	1001.0	20.0	19.4	8	16.5	23	8	36
EXPORT FREEDOM	WCJS	20	37.2 N	60.5 W	12	27	50	5 NM	02	0995.0	20.0	19.1	7	28	27	8	29.5
ADDIRIYAH	HZLL	20	39.2 N	49.5 W	22	24	M 58	1 NM	82	0979.5	17.5	19.5	10	39	24	8	39
ADDIRIYAH	HZLL	21	39.1 N	49.6 W	00	27	M 60			0983.2	15.5	19.5			29	9	39
ADDIRIYAH	HZLL	23	40.0 N	65.5 W	12	24	M 47	1 NM	07	0993.5	11.0	16.0	10	18	17	9	39
ADDIRIYAH	HZLL	24	39.4 N	67.5 W	06	27	M 50			1002.0	2.0	12.0	6	10	26	8	32.5
S.S. ROVER	KRBS	29	40.1 N	34.8 W	13	24	45	5 NM		1003.0	18.7	12.3	6	24.5	25	8	29.5
S.S. ROVER	KRBS	30	36.2 N	39.0 W	09	18	50	5 NM		0993.0	20.0	13.9	12	24.5	19	18	46
TFL FREEDOM	9VXX	30	37.4 N	39.4 W	12	24	M 50	5 NM	65	0987.0	16.5	18.5	7	19.5	26	12	32.5
S.S. ROVER	KRBS	30	36.0 N	39.3 W	13	27	55	5 NM	02	0997.0	17.4	15.0	6	28	22	6	44
	ATLANTIC	FEB.															
EXPORT FREEDOM	WCJS	1	33.3 N	71.1 W	12	29	45	5 NM	02	1013.0	12.3	20.0	8	19.5	29	10	39
USNS SEALIFT ANTARCTIC	KTYT	12	40.0 N	09.6 W	00	01	50	5 NM	25	1010.0	11.1	12.8	4	6.5	01	10	29.5
S.S. ROVER	KRBS	13	33.2 N	63.0 W	15	28	50	5 NM		1000.5	17.8	15.6	10	32.5	23	8	23
RAINBOW HOPE	KNDB	14	50.6 N	43.2 W	18	16	55	2 NM	64	0973.3	8.9	8.9	5	10	18	9	31
RAINBOW HOPE	KNDB	15	50.4 N	42.8 W	00	20	50	5 NM	26	0976.0	4.4		6	23	19	10	39
RAINBOW HOPE	KNDB	15	50.2 N	42.2 W	06	19	55	5 NM		0978.7	4.4		6	23	19	12	39
RAINBOW HOPE	KNDB	15	49.9 N	41.7 W	12	20	50	5 NM	83	0983.1	3.9	8.9	3	11.5	21	9	34.5
FEDERAL SEAWAY	KEBA	23	36.6 N	51.4 W	12	31	50	10 NM	15	1005.0	13.3	13.3	13	32.5			
EXPORT PATRIOT	WCJY	24	38.3 N	52.8 W	12	24	60			0975.0	16.7	18.3	6	24.5	24	11	44
BARRY ZAK	A7EX	24	36.1 N	59.2 W	18	30	M 46	2 NM	64	0998.0	10.5		7	13	30	10	32.5
	WSNH	24	34.0 N	41.7 W	18	20	45	2 NM	80	0989.0	18.5		7	21	21	10	36
	WSNH	25	33.4 N	41.9 W	00	23	45	2 NM	15	0991.0	19.5		7	21	22	10	36
	WSNH	25	32.6 N	42.3 W	06	27	50	5 NM	81	0993.8	13.0		9	21	28	10	39
TFL EXPRESS	9VPU	25	40.7 N	39.3 W	12	26	M 78	1 NM	07	0968.0	14.0	18.0	14	16.5	26	14	34.5
	WSNH	25	32.5 N	43.0 W	12	27	48	5 NM	87	0999.0	16.5		7	21	27	12	44
TFL EXPRESS	9VPU	25	40.7 N	40.0 W	18	25	M 64	5 NM	01	0976.2	13.0	17.8	12	16.5	26	15	39
	WSNH	25	32.7 N	43.6 W	18	27	46	5 NM	25	0999.2	16.0		7	19.5	28	11	42.5
TFL EXPRESS	9VPU	26	41.1 N	42.9 W	12	26	M 50	5 NM		0984.5	12.5	17.0	12	29.5			
	ATLANTIC	MAR.															
AMERICANA	IBPA	16	33.2 N	60.8 W	00	29	M 50	2 NM		1015.0	16.0	20.0	11	24.5	33	18	29.5
RAINBOW HOPE	KNDB	16	41.5 N	57.0 W	18	26	45	2 NM	18	0996.6	9.4	13.9	4	13	26	8	31
SEALAND LEADER	WSNH	30	38.0 N	54.4 W	18	03	45	2 NM	07	1010.0	15.0		4	10	02	12	46

Bathy-Tesac Data Received at NMC

January, February and March 1987

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
A8VI	21	21	0	PACDUCHESS
BNTA	4	4	0	***
CGCL	28	0	28	***
CGDV	189	189	0	W. TEMPLEMAN
CG2683	81	81	0	ALFRED NEEDLER
CSBL	17	17	0	***
CYWK	12	12	0	ENDEAVOR
C7C	255	0	255	OCEAN STATION CHARLIE
C7L	82	82	0	OCEAN STATION LIMA
DBFJ	91	91	0	FRITHJOF
DBFP	77	77	0	WALTER HERWIG
DBFU	1	1	0	***
DBKV	41	41	0	SEETEUFEL
DCH	13	13	0	ELBE I
DDMA	37	37	0	JEBSEN SOUTHLAND
DFPU	97	97	0	HANNOVER
DGFN	1	1	0	***
DGFR	22	22	0	MONTE OLIVIA
DGLM	65	65	0	MONTE ROSA
DGRL	54	54	0	RIKA
DGSR	62	62	0	MONTE SARMIENTO
DGUK	2	2	0	***
DGVK	81	81	0	COLUMBIA VICTORIA
DGZV	71	71	0	COLUMBUS VIRGINIA
DHCW	79	79	0	COLUMBUS WELLINGTON
DZLI	4	4	0	***
D5CW	5	5	0	SOUTH GLORY
D5NZ	88	88	0	POLYNESIA
ELDM8	27	27	0	***
ELDW8	62	62	0	SKRIM
ELED7	2	2	0	PACPRINCE
ELED8	17	17	0	PACPRINCESS
EREA	267	159	108	MONSOON
EREB	192	22	170	VOLNA
EREC	80	0	80	PRYLYV
EREH	80	25	55	PRIBOI
EREI	155	74	81	OCEAN
ERES	111	77	34	VICTOR BUGAEN
ERET	79	78	1	GEORGE OUSHAKOV
EREU	69	64	5	ERNST KRENKEL
ESGG	60	0	60	FROLOV VYACHESLAV
ESGU	57	4	53	PERCY 3
FABO	2	2	0	***
FNBA	98	98	0	CRYOS
FNBF	73	73	0	ROSTAND
FNCW	108	108	0	ROUSSEAU
FNDO	1	1	0	***
FNDS	1	1	0	***
FNDT	23	23	0	***

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
FNDU	22	22	0	ZAMBEZE
FNDZ	16	16	0	ZELANDE
FNFB	1	1	0	***
FNFD	5	5	0	***
FNGS	42	42	0	LAFAYETTE
FNIB	4	4	0	THALASSA
FNLZ	3	3	0	***
FNMZ	39	39	0	CORIOLIS
FNOM	18	18	0	ANGO
FNPA	29	29	0	***
FNSD	1	1	0	***
FNQB	21	21	0	***
FQBO	1	1	0	***
GACA	16	16	0	***
GPHH	4	4	0	***
HCGT	7	7	0	BUCCANEER
HLFX	1	1	0	PACBART
HPAN	22	22	0	MICRONESIAN COMMERCE
HPEW	42	42	0	PACIFIC ISLANDER
HSDY	21	21	0	***
H9BQ	73	73	0	MICRONESIAN INDEPENDENCE
JASQ	14	14	0	***
JAWD	7	7	0	***
JBES	43	43	0	YAMASHIN MARU
JBMS	53	53	0	HIKAWA MARU
JBOA	32	32	0	KEIFU MARU
JCCX	12	12	0	***
JCDF	118	118	0	SOYO MARU
JCDT	9	9	0	AMERICA MARU
JCGN	1	1	0	***
JCIN	11	11	0	TOKYO MARU
JDRD	21	21	0	SHOYU MARU
JFDG	70	70	0	SHUMPU MARU
JGZK	140	140	0	RYOFU MARU
JIOW	27	27	0	ALASKA MARU
JJZC	13	13	0	HAKONE MARU
JNQK	80	80	0	***
JNVF	108	108	0	KAIYO MARU
JPVB	61	61	0	SEIFU MARU
JQXW	23	23	0	HIERU MARU
KEOC	87	87	0	EDGAR M. QUEENY
KGWT	40	40	0	THOMPSON, T.G.
KGWU	114	114	0	WASHINGTON, T.
KIYO	37	37	0	EXXON JAMESTOWN
KNBO	2	2	0	DELAWARE II
LOAI	60	60	0	ALMIRANTE IRIZAR
LZTI	70	70	0	***
NAAO	112	112	0	GLACIER
NAQD	59	59	0	JARVIS
NARK	27	27	0	***
NDNR	2	2	0	***
NDWA	14	14	0	MORGENTHAU
NFKQ	1	1	0	SEALIFT ARABIAN SEA
NHNC	3	3	0	***
NHPA	4	4	0	***

Bathy-tesac Data Received at NMC cont'd

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
NHTE	56	56	0	ELROD
NHWR	9	9	0	MIDGETT
NIKL	3	3	0	TAMPA
NLGF	100	100	0	***
NLVS	49	49	0	RUSH
NMOB	53	53	0	***
NRUO	85	85	0	POLAR SEA
NYGG	19	19	0	CHAUVENET
OPQM	1	1	0	***
OWEQ	21	21	0	MC KINNEY MAERSK
OWEY	2	2	0	***
OXFB	28	28	0	***
OXND	26	26	0	LARS MAERSK
OXYL	18	18	0	BAMSA DAN
OYBG	15	15	0	FALSTRIA
PACM	1	1	0	PACIFIC MISSILE RANGE
PGDG	33	33	0	NEDLLOYD KINGSTON
PGOF	30	30	0	NEDLLOYD KEMBLA
PJYG	62	62	0	OLEANDER
PLAT	199	199	0	PLATFORM
PWSA	26	26	0	***
SCOV	1	1	0	TV 244
SCPE	1	1	0	TV 253
SEPI	3	3	0	***
SEXQ	3	3	0	TV 278
SGQJ	62	62	0	ELGAREN
SHPF	2	2	0	TV 281
SKUP	1	1	0	***
SKVP	3	3	0	***
SMZJ	1	1	0	TV 105
SMZQ	3	3	0	TV 102
SPEW	1	1	0	***
TEST	6	6	0	***
TESTP	4	4	0	***
TFXQ	16	16	0	RAKKAFOSS
UAAH	3	2	1	***
UAAX	272	127	145	VOYKOV
UBNZ	114	110	4	SHULEYKIN AKADEMIK
UEAK	172	83	89	VALERIAN URYVAYEV
UHQS	271	136	135	ACADEMIC KOROLEV
UJFO	140	138	2	MULTANOVSKIY PROF
ULYN	9	0	9	VERNADSKY
UMAY	255	125	130	ACADEMIC SHIRSHOV
UMFW	95	90	5	PROF. ZUBOV
UPUI	37	37	0	PROFESSOR VIZE
URVX	2	2	0	POLYARNDYE SIYANIYE
URYN	97	1	96	RUDOLF SAMOILOVICH
UUPB	118	59	59	AKADEMIK N. SHOKALSKIY
UVMJ	6	6	0	VSEVOLOD BERYOZKIN
UVMM	241	159	82	YAKOV GAKKEL
UWEC	271	149	122	KHROMOV PROFESSOR
UZDV	2	2	0	***
UZGH	82	77	5	PASSAT
UZVD	1	1	0	***
VCDT	35	35	0	CAPE ROGER

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
VCLG	68	68	0	***
VJBQ	24	24	0	***
VKCK	50	50	0	STUART
VKCN	80	80	0	CANBERRA
VKCV	30	30	0	DERWENT
VKLA	106	106	0	ADELAIDE
VKLB	39	39	0	HOBART
VKMK	12	12	0	***
VKML	49	49	0	SNIPE
VKMN	30	30	0	TEALE
VKMS	306	306	0	COOK
VLNB	157	157	0	TORRENS
VKNK	2	2	0	***
VMAP	117	117	0	AUSTRALIAN PROGRESS
VP05	1	1	0	AIRCRAFT
VP49	82	82	0	AIRCRAFT
VXN	98	98	0	AIRCRAFT
WCGN	53	53	0	CHEVRON CALIFORNIA
WHGA	9	9	0	R.D.CONRAD
WMVC	15	15	0	J.N.COBB
WMVF	27	27	0	ALBATROSS IV
WSC22	2	2	0	POINT SUR
WSE3385	93	93	0	GLORITA
WTDF	230	230	0	T. CROMWELL
WTDK	11	11	0	C.S. JORDAN
WTDM	69	69	0	M.FREEMAN
WTDO	14	14	0	OREGON II
WTED	114	114	0	CHAPMAN
WTEG	45	45	0	MOUNT MITCHELL
WTEP	3	3	0	OCEANOGRAPHER
WTER	34	34	0	RESEARCHER
WTES	24	24	0	SURVEYOR
WVFQ	9	9	0	ENDEAVOR
WXBR	44	44	0	CHEVRON MISSISSIPPI
WXQ7334	22	22	0	PETER ANDERSON
WYB8082	39	39	0	DAY STAR
WYR7512	59	59	0	BALD EAGLE
WZE3929	63	63	0	MOANA WAVE
XXXX	1092	1092	0	NO SHIP CALL SIGN REC'D
Y3CH	3	0	3	PROF. ALBRECHT PENCK
ZCSL	28	28	0	***
3FHI2	71	71	0	MOANA PACIFIC
5LFX	24	24	0	PACBARONESS
5MCB	10	10	0	PACMERCHANT
5MTA	27	27	0	PACMONARCH
7JBJ	5	5	0	RICHMOND BRIDGE
7JDU	226	226	0	***
7JOB	20	20	0	SHINKASHU MARU
7JWN	31	31	0	***
7KDD	9	9	0	YOKO MARU
8JNZ	71	71	0	KOFU MARU

TOTAL BATHYS RECEIVED 10203
TOTAL TESACS RECEIVED 1817
TOTAL REPORTS RECEIVED 12020

U. S. NDBC Climatological Data

March 1987

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN WAVE HT (M)	MAX WAVE HT (M)	MAX WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
32302	18.0S	085.1W	740	22.7	23.4	1.8	3.3	29/09	9.5	SE	19.4	30/06	1014.2
41001	34.9N	072.9W	735	15.2	19.9	3.2	9.2	10/23	14.7	NW	31.7	02/02	1016.3
41002	32.2N	075.3W	743	17.8		2.6	7.5	11/05	14.7	N	31.1	01/23	1017.0
41006	29.3N	077.4W	510	18.9	21.8	2.5	5.2	11/23	13.3	N	34.7	08/02	1016.7
42001	25.9N	089.7W	738	19.9	21.3	1.6	6.3	07/12	13.8	NE	34.4	07/04	1013.3
42002	26.0N	093.5W	743	20.3	22.9	1.6	5.4	30/22	14.1	NE	35.2	30/16	1014.2
42003	26.0N	085.9W	156	21.7	26.0				17.0	NE	37.4	07/06	1017.0
42014	29.3N	087.4W	743	17.4	19.7				12.3	N	31.1	24/05	1014.1
42107	30.1N	088.9W	741	15.1	18.6	0.6	2.1	18/04	10.3	N	29.1	18/06	1015.5
44004	38.5N	070.6W	743	9.5	13.9	2.9	7.7	14/16	13.3	N	34.1	14/02	1016.2
44005	42.7N	068.3W	741	1.5	3.0	1.9	4.9	02/19	12.6	N	27.7	10/03	1016.6
44007	43.5N	070.1W	703	1.2	3.0	1.1	4.0	02/07	10.9	N	27.2	01/22	1017.8
44008	40.5N	069.5W	309	5.3	4.3	2.5	5.5	31/19	14.7	NE	38.9	28/20	1013.6
44009	38.5N	074.6W	739	5.2	4.9	1.6	4.7	10/14	12.3	N	36.9	10/06	1018.2
44011	41.1N	066.6W	742	3.0	4.1	2.4	5.8	02/19	13.5	N	29.5	14/20	1015.0
44012	38.8N	074.6W	510	6.2		1.2	4.1	31/20	10.2	N	33.0	31/06	1016.6
44013	42.4N	070.8W	738	2.6	2.8	1.1	2.8	02/01	10.3	NE	27.2	10/04	1017.1
45001	48.0N	087.7W	742	-0.9		0.8	3.2	01/16	11.2	S	21.9	01/15	1020.7
45003	45.3N	082.8W	471	1.1	2.5	0.5	2.5	30/12	8.8	NW	25.3	31/11	1019.9
45007	42.7N	087.1W	245	3.4	3.3	0.7	2.8	30/03	9.8	E	23.3	30/00	1012.1
45008	44.3N	082.4W	490	1.1	1.5	0.6	2.7	31/15	8.0	N	25.3	31/06	1020.2
46001	56.3N	148.3W	743	3.4	4.6	2.8	6.7	28/05	12.8	SE	30.0	21/11	1006.7
46003	51.9N	155.9W	737	3.6	4.1	3.5	6.9	17/06	14.3	SW	31.3	14/15	1004.3
46004	50.9N	135.9W	744	6.1	7.0	3.2	6.3	05/00	14.5	W	27.3	04/22	1010.1
46005	46.1N	131.0W	742	8.8	9.8	3.0	6.4	04/19	12.5	SE	24.1	04/10	1012.0
46006	40.8N	137.6W	740	10.9	11.9	3.2	8.1	12/06	16.1	SE	33.9	04/23	1013.0
46010	46.2N	124.2W	741	9.4	9.7	2.6	5.9	03/23	12.6	S	36.9	03/22	1014.5
46013	38.2N	123.3W	742	11.3	11.5	2.6	6.2	05/03	13.4	NW	31.4	05/10	1017.6
46014	39.2N	124.0W	712	11.1	11.4	2.8	5.8	05/06	13.5	SE	33.8	05/03	1017.0
46016	63.3N	170.3W	244	-13.4					0.0	N			1009.5
46022	40.7N	124.5W	241	10.9	10.9	2.3	3.9	21/22	13.4	N	23.9	23/07	1021.1
46023	34.3N	120.7W	725	12.4	12.9	2.5	5.3	14/05	13.5	NW	29.3	16/05	1016.9
46025	33.7N	119.1W	742	13.9	14.5	1.4	3.1	16/00	9.2	W	29.8	15/20	1016.3
46026	37.8N	122.7W	716	11.7	11.9	2.1	4.4	13/03	10.9	NW	27.8	05/05	1017.5
46027	41.8N	124.4W	737	10.2	10.3	2.7	6.3	04/18	14.5	S	38.9	10/21	1016.6
46028	35.8N	121.9W	742	12.4	13.0	2.6	5.1	15/22	12.1	NW	25.5	16/00	1018.3
46035	57.0N	177.7W	744		2.4	3.4	10.1	21/06	7.8	N	37.9	20/19	998.8
46036	48.3N	133.9W	742	7.5	8.7	3.1	6.9	05/23	12.7	W	27.6	17/01	1011.1
46039	48.2N	123.4W	485	8.5	8.7	0.4	2.0	26/04	5.7	W	27.2	26/05	1013.0
51001	23.4N	162.3W	743	21.3	21.6	2.8	5.6	02/09	11.3	E	24.7	31/08	1019.5
51002	17.2N	157.8W	741	23.8	24.6	2.5	4.0	12/17	14.0	E	24.8	21/10	1016.0
51003	19.2N	160.8W	743	23.4	24.8	2.6	4.6	04/13	11.4	NE	22.0	29/11	1016.9
51005	20.4N	156.1W	742	22.7	24.0	1.8	3.4	21/06	16.3	NE	27.2	03/11	1017.7
ALRF1	24.9N	080.6W	743	22.2					15.9	E	44.1	07/07	1014.9
ALSN6	40.5N	073.8W	738	5.4	4.1				13.6	NE	45.1	31/19	1018.5
BURL1	28.9N	089.4W	738	15.1					13.0	N	35.1	18/06	1015.2

U.S. NDBC Climatological Data cont'd

March 1987

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN WAVE HT (M)	MAX WAVE HT (M)	MAX WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
BUZM3	41.4N	071.0W	741	3.0					14.9	N	42.1	31/19	1018.0
CARO3	43.3N	124.4W	741	9.8					9.8	S	36.1	03/09	1016.0
CHLV2	36.9N	075.7W	738	6.7	5.1	1.3	4.5	10/15	15.8	N	47.1	10/09	1018.6
CLKN7	34.6N	076.5W	703	10.2					11.9	N	34.1	10/21	1017.6
CSBF1	29.7N	085.4W	738	15.8					6.4	E	27.0	30/21	1015.3
DBLN6	42.5N	079.4W	674	2.3					9.7	SW	36.1	02/08	1005.0
DESW1	47.7N	124.5W	743	8.3					12.9	SE	48.1	04/23	1013.8
DISW3	47.1N	090.7W	742	0.2					12.1	NE	33.1	01/00	
DPIA1	30.3N	088.1W	743	15.1	15.8				11.3	N	34.6	18/07	1014.9
DSLN7	35.2N	075.3W	742	9.9	9.8				18.8	N	54.1	01/18	1017.8
FBIS1	32.7N	079.9W	742	12.1					8.9	E	24.0	01/13	1012.1
FFIA2	57.3N	133.6W	739	2.5					13.7	N	37.1	04/16	1013.7
FPSN7	33.5N	077.6W	744	14.0	18.5				15.8	N	39.1	01/13	1017.3
GDIL1	29.3N	090.0W	412	14.7	15.9				10.3	NE	24.0	07/13	1018.6
GLLN6	43.9N	076.4W	697	1.5					9.2	N	31.0	02/21	1018.5
IOSN3	43.0N	070.6W	741	2.1					12.6	N	38.1	31/19	1017.8
LKWF1	26.6N	080.0W	742	21.2	22.8				13.0	SE	30.0	07/10	1018.2
MDRM1	44.0N	068.1W	742	0.2					16.2	N	41.1	02/04	1017.5
MISM1	43.8N	068.9W	743	0.6					15.9	N	48.1	02/00	1017.6
NWPO3	44.6N	124.1W	741	9.3					10.2	E	33.1	02/14	1015.0
PILM4	48.2N	088.4W	744	-1.0					10.7	N	31.0	01/03	1021.1
PTAC1	39.0N	123.7W	744	10.2					11.3	N	32.0	05/02	1016.6
PTAT2	27.8N	097.1W	740	16.1					9.4	NE	30.0	29/11	1015.4
PTGC1	34.6N	120.7W	743	12.3					14.1	N	38.1	15/16	1016.8
ROAM4	47.9N	089.3W	741	-0.6	1.9				14.4	NE	34.1	08/14	1020.9
SAUF1	29.9N	081.3W	699	15.0					8.6	N	23.0	06/21	1015.8
SBIO1	41.6N	082.8W	741	2.9					10.7	E	30.0	02/02	1018.9
SGNW3	43.8N	087.7W	720	1.9	3.1				11.5	NE	40.1	09/04	1016.9
SISW1	48.3N	122.8W	735	8.7					9.6	SE	41.1	26/01	1013.8
SPGF1	26.7N	079.0W	733	21.6	23.6				8.5	E	24.0	31/22	1016.6
SRST2	29.7N	094.1W	743	14.6					7.8	SE	23.0	17/00	1015.5
STDM4	47.2N	087.2W	741	-0.1					16.3	S	37.1	02/10	
SVLS1	32.0N	080.7W	743	13.0					14.3	NE	34.1	31/09	1016.7
TPLM2	38.9N	076.4W	742	6.9	5.6				10.0	N	31.0	10/07	1018.2
TTIW1	48.4N	124.7W	744	8.4					14.2	E	38.1	03/08	1014.0
VENF1	27.1N	082.5W	705	18.6	20.0				9.8	NE	31.0	31/06	1013.0
WPOW1	47.7N	122.4W	741	8.3					6.8	S	24.0	17/12	1014.9

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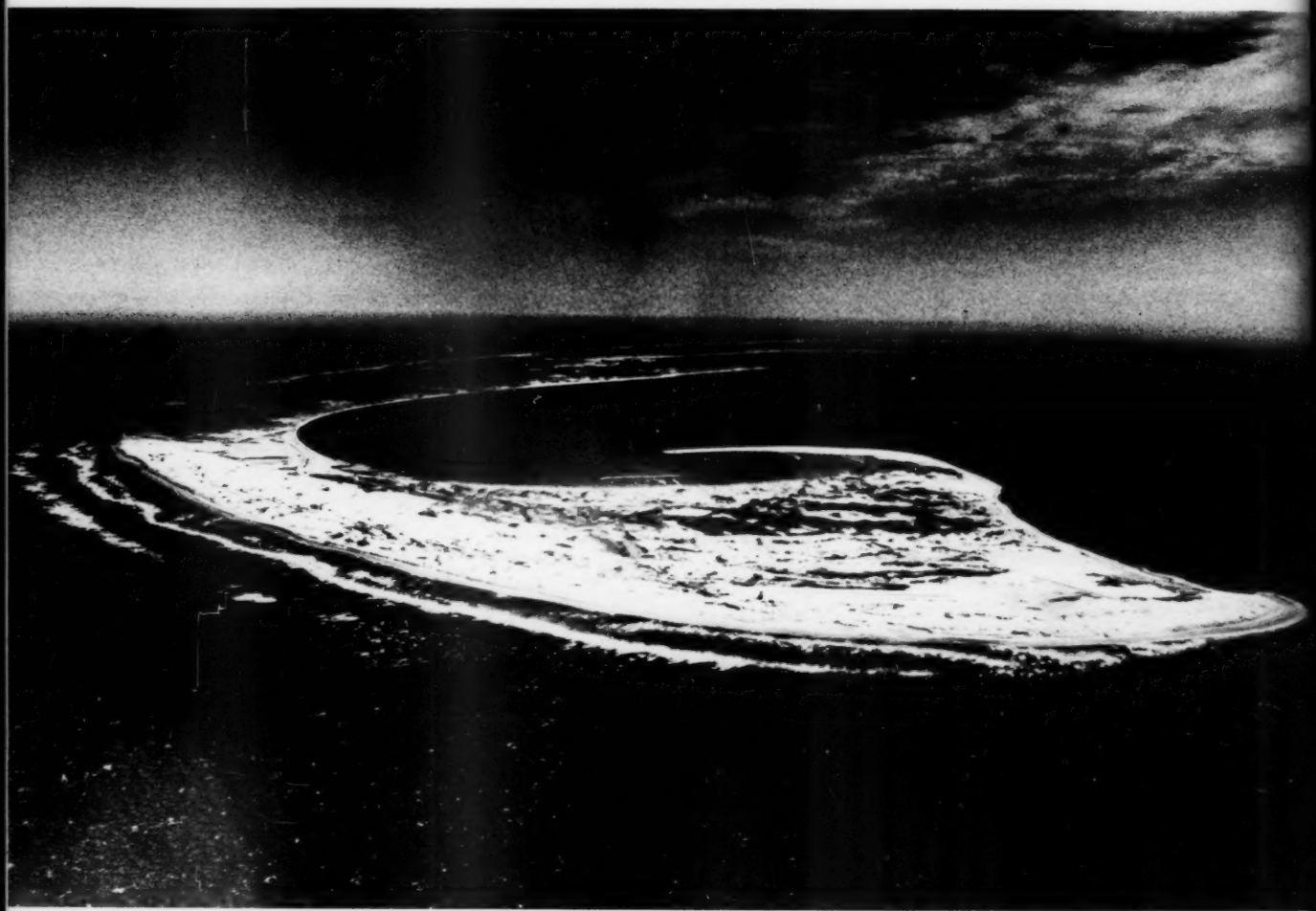

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